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MAY 8 1912

POWER

Volume 35, No. 19.
Issued Every Tuesday.
Hill Publishing Company.

NEW YORK, MAY 7, 1912.

Price, 5 cents.
Outline of Topics, 70.
Index to Advertisers, 60.

We Claim That Schieren's Duxbak Waterproof Leather-Belting Is Absolutely Waterproof—

We Claim it has least stretch and shrink
——— it is made of A-1 Centre Stock
——— it has maximum strength
——— it has least slippage
——— it will not pulley burn
——— it will outlast other beltings

Send a description of the drive you wish to try "Duxbak" on and what your trouble with other beltings have been and we'll supply the right belt for the job.

DUXBAK BELTING
TRADE MARK

Chas. A. Schieren Company
ESTABLISHED 1868

Tanners
Belt Manufacturers

New York, 69 Cliff Street

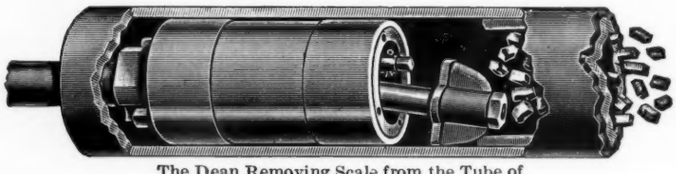
Chicago, 123 W. Kinzie St.
Boston, 641-643 Atlantic Ave., Opp. South Station
Philadelphia, 226 North Third St.
Pittsburg, 205 Wood St
Denver, 1752 Arapahoe St.
Brooklyn, N. Y., Cor. 13th St. and 3d Ave
Hamburg, Germany. Auf dem Sande 1

Oak Leather Tanneries, Bristol, Tenn.

IF your coal bills are big—
your boiler capacity is taxed—
the boilers leak every now and then where the tube-end and header join—
the boilers won't stand crowding—

See If The Trouble Does Not Come From Scale!

Perhaps you think there is no scale because your feed water is clean or filtered—or you are using a boiler-compound—or have some other equally good reason.



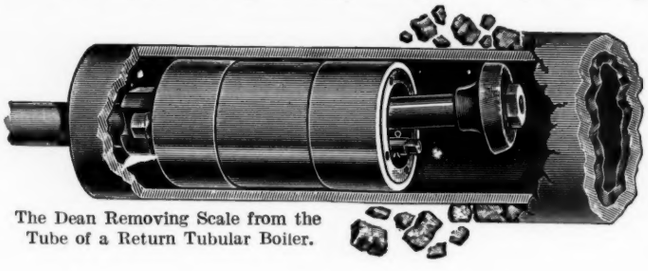
The Dean Removing Scale from the Tube of a Water Tube Boiler.

But stop guessing and make sure. You can't examine a tube from end to end, inside and out, except by removing it, or using

The Dean Boiler Tube Cleaner

Let us send you one on trial.

It won't cost you anything to try, and you will know for sure then.



The Dean Removing Scale from the Tube of a Return Tubular Boiler.

Many a ton of scale have we seen removed from boilers that everyone about the plant said were clean.

Maybe you might want to buy a Dean if you got anywhere near a ton of scale from a "clean" boiler.

Want our booklet "Scale Removal Made Easy" first?

The Wm. B. Pierce Company

Jewett Bldg. Chicago Office: 801 Steinway Bldg. **Buffalo, N. Y.**

KEYSTONE GREASE

KEYSTONE TRADE MARK REGISTERED U.S. PAT. OFF.

If You're Fixed Like This We'll Gladly Wait

But unless you are in this condition—or equally badly off—we fail to see why you should wait a minute longer before sending for the free Can of Keystone Grease, Grease Cup and Cap.

Now, as a matter of fact, why *should* you?

Lubrication is a matter of first importance to you. KEYSTONE GREASE is at least worth *trying*. And it will cost you absolutely nothing to make that trial—we even send the necessary Grease Cup free.

Then why delay?

The coupon's the answer. Return it now.

KEYSTONE LUBRICATING CO.

Executive Offices and Works

21st, Clearfield and Lippincott Streets Philadelphia, Pa.

Branch offices and warehouses in the principal cities of the United States.
Agencies in the principal countries throughout the world.

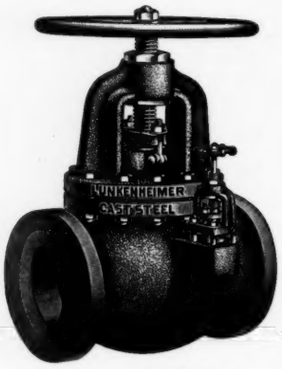
No Connection With The Oil Trust

A SAMPLE FREE

KEYSTONE LUBRICATING COMPANY, Phila.

Please send us a large size sample of Keystone Grease, sufficient for testing purposes, and a substantial Grease Cup and Free Engineer's Cap. It is thoroughly understood that no charges whatsoever will be made for sample, cup or cap, and all express charges will be paid by you.

Name of bearing where sample will be tested . . . . . .
Its width . . . . . Combined horse power of engines . . . . . .
Tap size of cup . . . . . .
FIRM . . . . . .
Per . . . . . .
City . . . . . State . . . . . .
Size cap required. . . . . **CUT OUT THIS COUPON AND MAIL IT TO-DAY** **Dept. B—5-7-12**



"Samson" Globe Valves.

"Victor" Gate Valves.

Non-return Safety Boiler Stop Valves

LUNKENHEIMER CAST STEEL VALVES

For extreme conditions of pressure, superheat and strain, ***Lunkenheimer Cast Steel Valves*** are unexcelled.

They are the ***only cast steel valves that meet the specifications of the American Society for Testing Materials.*** Perfect, solid castings, free from blow-holes, are assured, and unlike other steel valves, the cast steel used in our valves is annealed, thereby relieving all internal stress and making fine crystalline grains so essential to strong steel.

The ***tensile strength*** of ***Lunkenheimer Cast Steel*** is about ***80,000 pounds*** per square inch, with a safe elastic limit and excellent elongation.

The valves are exceptionally durable, and ***all parts subjected to wear can easily be renewed*** when worn.

They are of extra heavy construction, well made in every detail, carefully tested and inspected and are guaranteed in every particular.

To suit the requirements of various conditions of superheat and high pressure, and also to meet the specifications of engineers who may differ as to what is best suited to the purpose, ***Lunkenheimer Cast Steel Valves*** are made in two combinations as regards the material used for the trimmings.

The line includes Globe, Angle, Gate, Non-return Boiler Stop Valves, etc.

Specify and insist upon securing genuine ***Lunkenheimer make.*** Do not accept substitutes,—they are never as good as the genuine.

"MOST supply houses sell them—yours CAN—if they DONT or WONT,—tell *US.*"

Write for 1912 Catalog.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High Grade Engineering Specialties in the World.

General Offices and Works: Cincinnati, Ohio, U. S. A.

NEW YORK	CHICAGO	BOSTON	LONDON, S.E.,
64-68 Fulton St.	186 N. Dearborn St.	138 High St.	35 Great Dover St.

SMILE

Show your employer a reduced coal bill—he'll smile and you'll smile—

Show him that your boilers are always clean—that boiler repairs are low—he'll smile and you'll smile. Show him that you get maximum results from boilers—no long shut downs for cleaning—no bagging plates; he'll smile and you'll smile.

Show him that scale, corrosion, foaming and all the boiler troubles which the average engineer has to put up with are absent in your plant—he'll smile and you'll smile.

Because work well done—results improved—overhead expenses reduced, always please the boss and show him that his engineer is keenly interested in his work.

Moreover a clean boiler means more time for yourself—no night work, no Sunday work, no coming to work on Holidays to clean out scale.

Dearborn Treatment will help you secure *continually clean* boilers—it is made after careful analysis of your feed water *to fit your particular feed water* conditions.

We analyze over 8000 feed water samples annually—send gallon of your feed water for free analysis today. We will send you some interesting facts and figures as applied to your boiler cleaning problem.

DEARBORN DRUG & CHEMICAL WORKS

Robert F. Carr, President

General Offices, Laboratory and Works
Chicago

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New York

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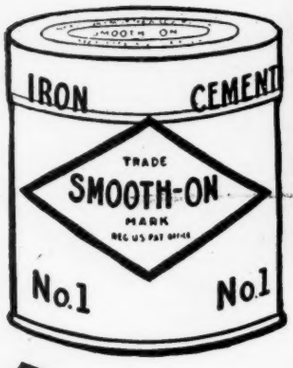

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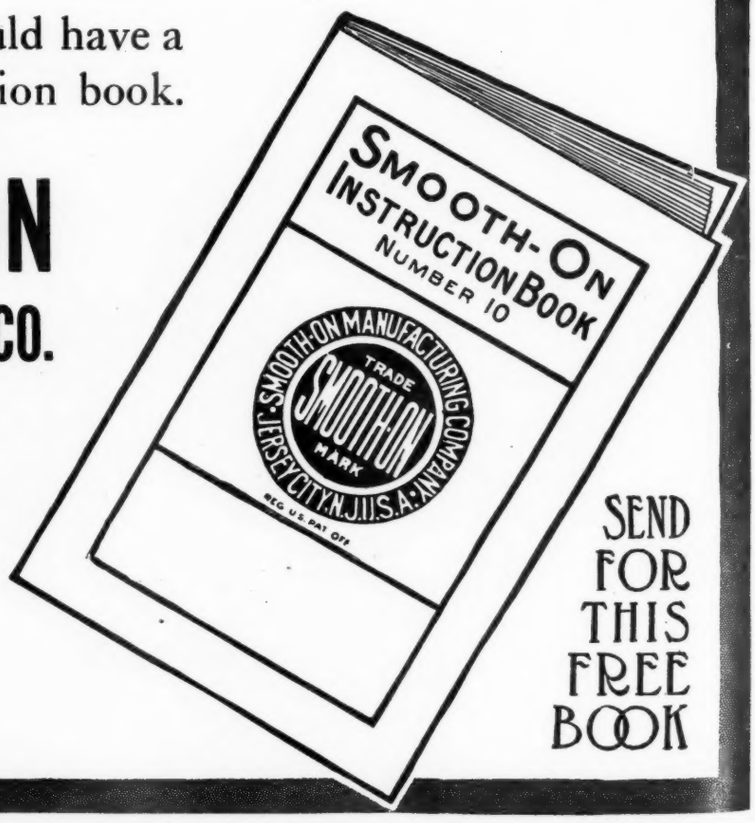
IRON CEMENTS

Positively stop all leaks of steam, water, fire or oil in iron, steel or concrete. They are easy to apply, harden quickly and make permanent repairs; proved by years in use.

Every engineer should have a copy of our instruction book.



SEND FOR THIS FREE BOOK

SMOOTH-ON MANUFACTURING CO.

Jersey City, N. J.

231 N. Jefferson St., Chicago

36 Sacramento St.
San Francisco, Cal.

8 White St., Moorfields, E.C.
London

POWER

Vol. 35 NEW YORK, MAY 7, 1912 No. 19

"Engineers All Dead"

THIS sentence was a part of the official report sent to the White Star Company in England regarding the recent "Titanic" disaster.

No mention of brave acts, of heroic rescues or of fidelity to duty, just "Engineers All Dead."

The "Titanic" carried a regular engine-room force of 34; with the stokers, coal passers and trimmers, a total of approximately 290 men. Not an engineer was saved, and with the exception of a few firemen, all of these are dead.

Two-thirds of these men were off duty when the ship struck the iceberg. They at least had a fighting chance, but the rules governing their actions were, in case of accident every man to his post.

Not on deck where there was a chance to cling to floating wreckage, but down in the ship's bottom, 122 ft. below the boat's deck. Not to stations where the gradual settling of the hull in the icy water could be seen, but down below where the desperate nature of the damage to the ship was evident.

Down where they could note the rapidly rising water, the failure of the pumps to keep it down, and know with a certainty that the ship was doomed.

But for these men the lights of the "Titanic" would not have glowed until shortly before she sank; but for the lights a panic among the passengers would have occurred, with a still greater appalling loss of life.

These engineers were not deceived. They knew that when they had done their duty, death awaited them. And they performed that duty; we know it, for the dispatch "Engineers All Dead" is conclusive evidence.

Marine engineers have scant chance of being saved when large ships are wrecked, for duty demands that they stay at their station. No chance to escape in charge of a ship's boat loaded with passengers, no opportunity to hear the order, "every man for himself." They stand by obeying signals until it is too late to gain the deck, and then they die like men—heroes every one.

Two hours is an eternity under such circumstances as surrounded the sinking of the "Titanic." Within ten minutes after the ice tore through the ship's side, these men knew that they were doomed. They had two hours to decide whether they would die doing their duty, or whether they would attempt to escape in one of the few life boats.

They chose to die. No excuses are being made by them as to how they were saved.

It is hard to die in the light, but more so in the dark interior of a sinking ship, where the bubbling of the inrushing water sounds the funeral dirge.

Carnage? Yes, and then some. Love of life and family would almost drag them away from their post, but fidelity to duty was the stronger, and won the battle.

And when they had done all that humans could do, had kept the lights bright and the pumps going until the fatal plunge, they clasped hands in a last farewell and went down with their ship.

We pay tribute to the heroism of these engineers who died that others might live, and, when the Recording Angel squares accounts, what more fitting entry could be written, regardless of creed or belief, than the significant words, "Engineers All Dead"?

Power Plant Recording System

By L. R. W. Allison

Forms used in making requisition for material and routine employed to keep complete and accurate record of all material issued.

Manner of indexing material received, on hand and issued.

Manner of recording information concerning motor and meter installations, etc.

The value of a system for recording, together with the printed forms and mode of procedure, whether employed for material, costs, kilowatts, revenue or the miscellanea connected with the lighting and power business, lies in its ability to render positive service at minimum expense and indirectly netting pecuniary value in its performance.

There are in use almost countless dispositions for registering stock and material required, purchased and supplied, with which the engineer is expressly interested for continuous operation. From the verbal orders of the operator in the small isolated plant to the formal printed blanks of a public-utility company whose plants may be located at distances from a main center, there are many methods which are essentially wanting in actual value.

No competent requisition or store system has been devised in a day and neither has it been a product of but one mind. It is perfected by a gradual growth; it is the result of experiments and trials of collective association, and is founded upon the demands of the plant in harmony with the office establishment.

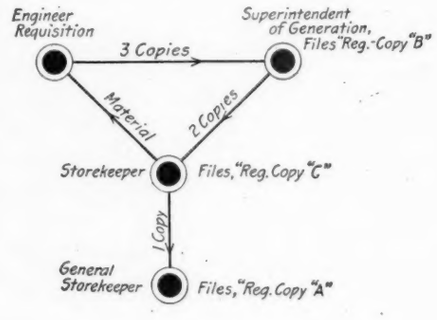
In power-plant work the system must necessarily fit the conditions of the business; it must offer accurate and prompt service to the engineer and at the same time protect the company from all needless expense.

Within a score of years, the Pacific Light and Power Company, of Los Angeles, Cal., has grown to such proportions as to affect generating plants from Borel, on Kern river, to Redondo beach, and serve territory in Los Angeles and San Bernardino counties with energy for lighting and power. With this augmentation has come the need for a store and supply system entirely within the jurisdiction of the main offices. The accompanying features of the process employed have been in satisfactory use for some time and have served all departments. Only the power-plant end will be considered here.

Requisitions for Material in Stock

Requisition books containing the form shown in Fig. 1 are supplied to the chief engineer and chief operator in charge at each of the various stations. Each requisition is numbered as shown, and is in triplicate, a blue, white and yellow sheet, lettered A, B and C respectively, one original and two carbon copies.

Space is provided for notation in the upper right corner for the designation of the job for which the material is required, as follows: "superintendent's order number," for such work ordered by the superintendent of generation, who has direct charge of all steam and hydraulic plants; "estimate number," for such special construction work as has been estimated in cost and approved by the general manager; "standing-order number," for regular maintenance and repair work, each class being segregated for the particular station and a number given, as "maintenance of generators and exciters, 5365," "maintenance of steam engines,



F'G. 2

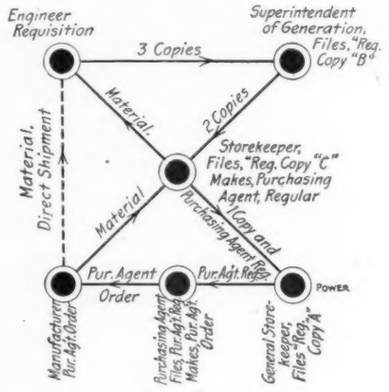
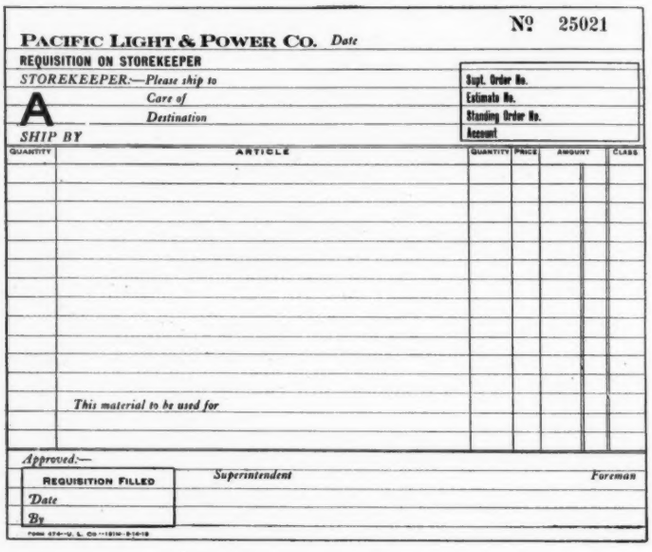


FIG. 3



PACIFIC LIGHT & POWER CO. Date

No. 25021

REQUISITION ON STOREKEEPER

STOREKEEPER:—Please ship to

A

Care of

Destination

SHIP BY

Supt. Order No.
Estimate No.
Standing Order No.
Account

QUANTITY	ARTICLE	QUANTITY	PRICE	AMOUNT	CLASS

This material to be used for

Approved:—

REQUISITION FILLED

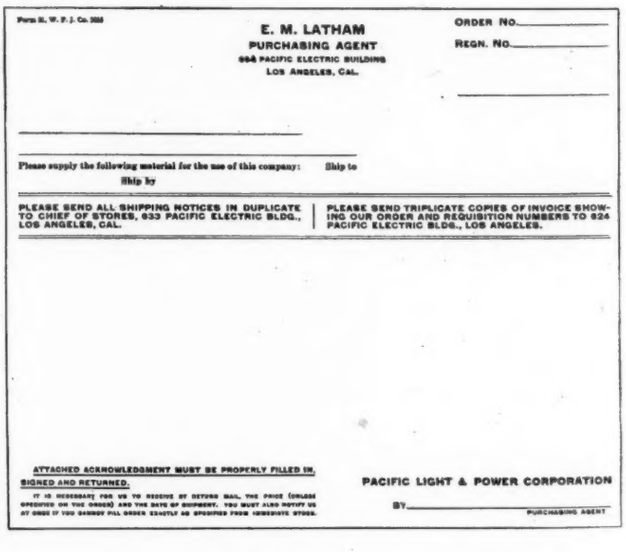
Date

By

Superintendent

Foreman

FIG. 1. REQUISITION FOR MATERIAL IN STOCK



E. M. LATHAM
PURCHASING AGENT
624 PACIFIC ELECTRIC BUILDING
LOS ANGELES, CAL.

ORDER NO.
REQN. NO.

Please supply the following material for the use of this company: Ship to

Ship by

PLEASE SEND ALL SHIPPING NOTICES IN DUPLICATE TO CHIEF OF STORES, 633 PACIFIC ELECTRIC BLDG., LOS ANGELES, CAL.

PLEASE SEND TRIPLICATE COPIES OF INVOICE SHOWING OUR ORDER AND REQUISITION NUMBERS TO 624 PACIFIC ELECTRIC BLDG., LOS ANGELES.

ATTACHED ACKNOWLEDGMENT MUST BE PROPERLY FILLED IN, SIGNED AND RETURNED.

IT IS NECESSARY FOR US TO RECEIVE BY RETURN MAIL THE PRICE (UNLESS SPECIFIED ON THE ORDER) AND THE DATE OF SHIPMENT. YOU MUST ALSO NOTIFY US AT ONCE IF YOU CANNOT FILL ORDER EXACTLY AS SPECIFIED FROM IMMEDIATE STOCK.

PACIFIC LIGHT & POWER CORPORATION

BY

PURCHASING AGENT

FIG. 4. PURCHASING AGENT'S ORDER

5379," and the like. The "account" line is for recording purposes at headquarters.

Each item of material needed, with its quantity and what it is to be used for, together with necessary shipping directions, is listed in the sections provided. The columns at the right, marked "quantity," "price," etc., are for the use of the storekeeper. All requisitions must bear the signature of the engineer or operator in charge on the line designated "foreman" and must be approved by the superintendent. The disposition of the proved by the superintendent, it follows the routine noted in Fig. 3. In this instance, the storekeeper, retaining copy C, as before, relists the material on a "purchasing-agent's requisition," this being identical with the form in Fig. 1 except for the omission of the five vertical columns at the right and the accompanying notations; it is likewise in triplicate.

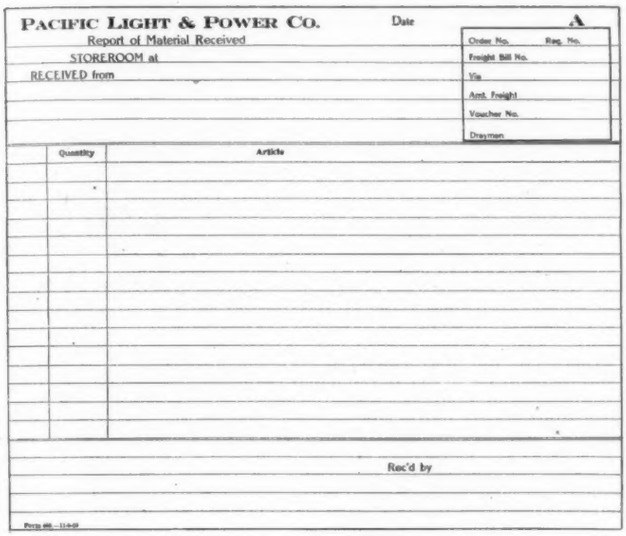

PACIFIC LIGHT & POWER CO. Date A
Report of Material Received
STOREROOM at
RECEIVED from
Order No. Req. No.
Freight Bill No.
Via
Amt. Freight
Voucher No.
Draymen
Quantity Article
Rec'd by

FIG. 5. "MATERIAL RECEIVED" BLANK

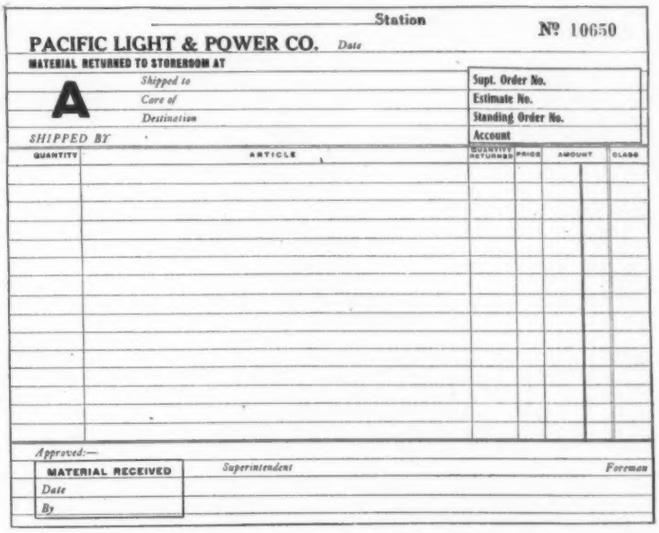

Station
PACIFIC LIGHT & POWER CO. Date
№ 10650
MATERIAL RETURNED TO STOREROOM AT
A
Shipped to
Care of
Destination
SHIPPED BY
Supt. Order No.
Estimate No.
Standing Order No.
Account
QUANTITY ARTICLE QUANTITY RETURNED PRICE AMOUNT CLASS
Approved:—
MATERIAL RECEIVED
Date
By
Superintendent
Foreman

FIG. 6. BLANK FOR MATERIAL RETURNED TO STOREROOM

The purchasing agent's order, Fig. 4, is issued to the manufacturer with the original requisition number and an order number to afford record for the invoice. This is made out in duplicate to the recipient of the order, one copy to be returned to the purchasing agent as acceptance for the material specified. Additional copies are made, of individual colors, for the general manager, general storekeeper, storekeeper, superintendent and the engineer who signed the requisition.

REPORT FOR MATERIAL RECEIVED BY ENGINEER

When material is received by the engineer in charge directly from the dealer without passing through the storeroom, as where direct shipment is made to a station at an isolated point from the main office, the "material received" blank, shown in Fig. 5, is employed. This is made out, by use of carbon, in quadruplicate, notated as A, B, C and D, in pink, yellow, white and blue respectively. The engineer, retaining the C copy,

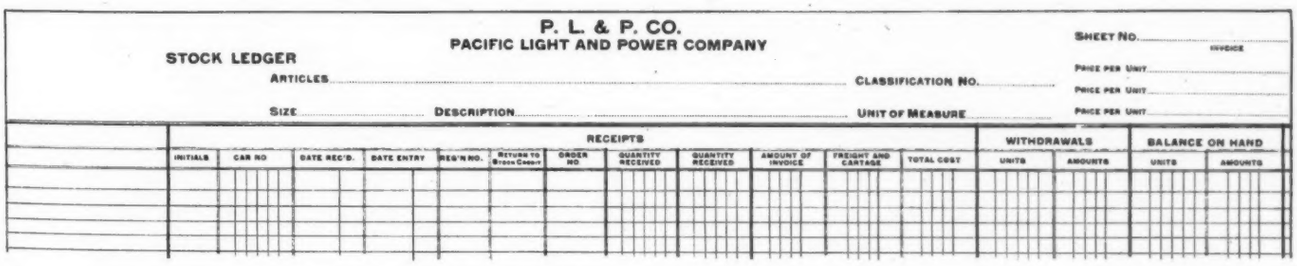

P. L. & P. CO.
PACIFIC LIGHT AND POWER COMPANY
STOCK LEDGER
SHEET NO.
INVOICE
ARTICLES
CLASSIFICATION NO.
PRICE PER UNIT
SIZE
DESCRIPTION
UNIT OF MEASURE
PRICE PER UNIT
PRICE PER UNIT
RECEIPTS
WITHDRAWALS
BALANCE ON HAND
INITIALS CAR NO DATE REC'D DATE ENTRY REC'N NO. RETURN TO STOCK CREDIT ORDER NO QUANTITY RECEIVED QUANTITY RECEIVED AMOUNT OF INVOICE FREIGHT AND CARTAGE TOTAL COST UNITS AMOUNTS UNITS AMOUNTS

FIG. 7. LOOSE-LEAF LEDGER RECORD OF STOCK

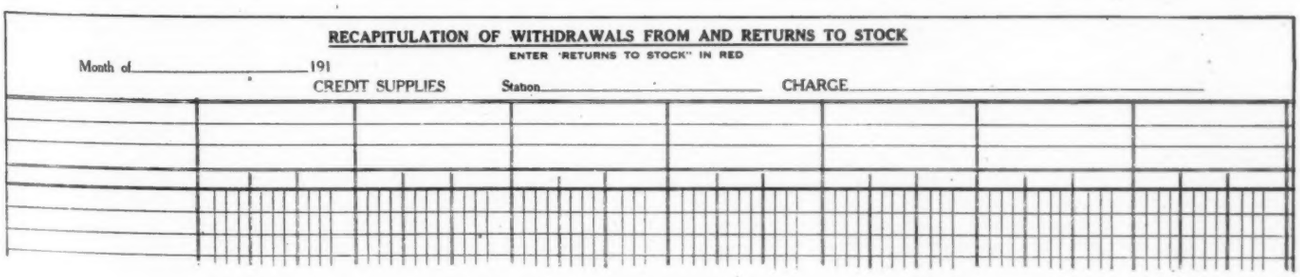

RECAPITULATION OF WITHDRAWALS FROM AND RETURNS TO STOCK
ENTER "RETURNS TO STOCK" IN RED
Month of 191
CREDIT SUPPLIES Station CHARGE

FIG. 8. BLANK FOR RECORDING RECAPITULATION OF STOCK

three requisition copies, and the supply of material, takes a course as shown in Fig. 2.

REQUISITIONS FOR MATERIAL TO BE PURCHASED

When special material is to be purchased, the requisition is additionally marked, if necessary, with the type of manufacture desired. After being approved by the superintendent, it follows the routine noted in Fig. 3. In this instance, the storekeeper, retaining copy C, as before, relists the material on a "purchasing-agent's requisition," this being identical with the form in Fig. 1 except for the omission of the five vertical columns at the right and the accompanying notations; it is likewise in triplicate.

The purchasing agent's order, Fig. 4, is issued to the manufacturer with the original requisition number and an order number to afford record for the invoice. This is made out in duplicate to the recipient of the order, one copy to be returned to the purchasing agent as acceptance for the material specified. Additional copies are made, of individual colors, for the general manager, general storekeeper, storekeeper, superintendent and the engineer who signed the requisition.

REPORT FOR MATERIAL RECEIVED BY ENGINEER

When material is received by the engineer in charge directly from the dealer without passing through the storeroom, as where direct shipment is made to a station at an isolated point from the main office, the "material received" blank, shown in Fig. 5, is employed. This is made out, by use of carbon, in quadruplicate, notated as A, B, C and D, in pink, yellow, white and blue respectively. The engineer, retaining the C copy, forwards the additional three to the superintendent, which, being approved by him, are distributed to the storekeeper, chief storekeeper and price clerk. This serves to protect the engineer and affords the company an absolute check on expenses for material so received, as no remittance is made for the invoice until a report from the operator is on record

and found to tally therewith. A "call for the receipt of goods" is issued by the price clerk to the engineer in charge, passing by way of the superintendent when this report is not received in due time.

Material Returned to Storeroom

For such material as may be received from the storeroom by the engineer and not placed in service, provision is made for its formal return and the proper credit is given by use of the form in

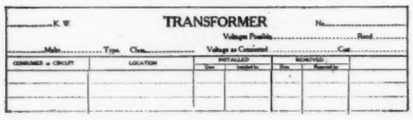


Fig. 9. Transformer Installation

Fig. 6. This is issued in triplicate by the engineer, one copy being retained for his record, the others, after approval by the superintendent, going to the storekeeper and the general storekeeper as in the case of the requisition for stock articles.

The various colors assist in definite disposal as each has its respective department for filing, with the purpose of such, whether for material desired, material returned, etc., easily noted.

Records of Stock

Records of stock on hand, additions to, withdrawals from, etc., are made in a

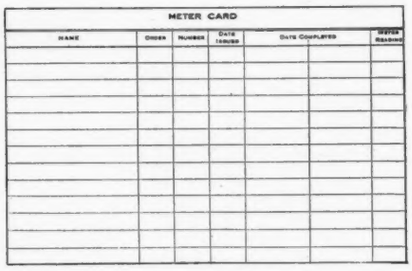


Fig. 11*a*. Meter Card

loose-leaf ledger, with 10¼x16-inch sheets, and ruled as in Fig. 7. Recapitulation of stock is recorded on an 8½x14¾-inch form, Fig. 8, all "returns to stock" being noted in red for quick reference. These forms give the company an accurate record of stock disposition and stock on hand at minimum labor.

Transformer and Motor Installation

A record of transformers installed or removed is made on the cards shown in Fig. 9; these are of light-weight 4¾x8-inch stock. Consumers supplied, the capacity and load on the transformer, together with other information as will be noted, are kept on file.

For motor installation, both sides of a 4½x9¾-inch card in the form given in Fig. 10 are employed. The record is complete, from the consumer, location and purpose for which used, to test the data and the equipment installed for proper connection. These cards are especially

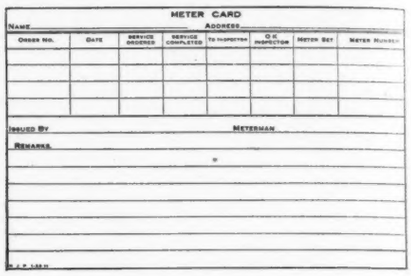


Fig. 11*b*. Reverse Side

valuable for reference when trouble is manifested in operation long after the date of installation.

Meter Records

The form shown in Fig. 11, printed on a 4x6-inch card, is for recording data

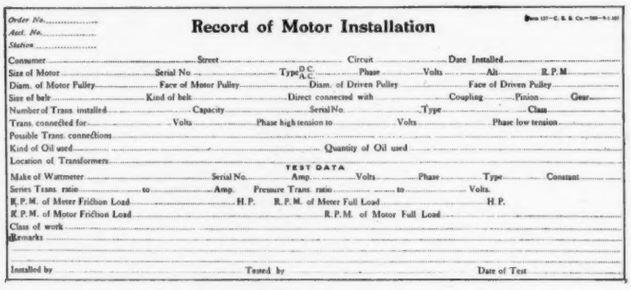


Fig. 10*a*. Front of Motor Installation Record Card

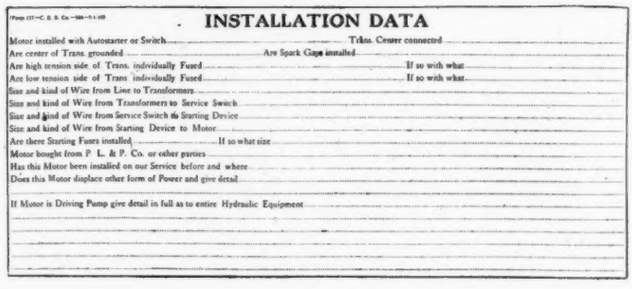

INSTALLATION DATA
Motor installed with Autostarter or Switch
Trans. Center connected
Are center of Trans. grounded
Are Spark Gaps installed
Are high tension side of Trans. individually Fused
If so with what
Are low tension side of Trans individually Fused
If so with what
Size and kind of Wire from Line to Transformers
Size and kind of Wire from Transformers to Service Switch
Size and kind of Wire from Service Switch to Starting Device
Size and kind of Wire from Starting Device to Motor
Are there Starting Fuses installed
If so what size
Motor bought from P. L. & P. Co. or other parties
Has this Motor been installed on our Service before and where
Does this Motor displace other form of Power and give detail
If Motor is Driving Pump give detail in full as to entire Hydraulic Equipment

Fig. 10*b*. Installation Data on Back of Card

Material Returned by Storeroom

Material placed in the storeroom or held in reserve by the storekeeper for a particular station through special circumstances and later delivered to the engineer, is cared for by means of a blank practically identical with the form shown in Fig. 6 and designated "material returned by storeroom to foreman." Three copies are prepared and pass in the routine as indicated.

All forms are uniformly 7½x8½ inches.

Transformer and Motor Installation

A record of transformers installed or removed is made on the cards shown in Fig. 9; these are of light-weight 4¾x8-inch stock. Consumers supplied, the capacity and load on the transformer, together with other information as will be noted, are kept on file.

For motor installation, both sides of a 4½x9¾-inch card in the form given in Fig. 10 are employed. The record is complete, from the consumer, location and purpose for which used, to test the data and the equipment installed for proper connection. These cards are especially valuable for reference when trouble is manifested in operation long after the date of installation.

Meter Records

The form shown in Fig. 11, printed on a 4x6-inch card, is for recording data connected with the installation of meters for consumers. The card, Fig. 12, gives on one side information regarding the circuit, the meter and the meter load, and on the reverse side a record of incandescent- or tungsten-lamp renewals. This form is 5x8 inches in size.

All cards for transformer, motor and meter installations and operating data are filed vertically in cabinet drawers in card-index style. They are arranged alphabetically, according to name or location, as conditions warrant.

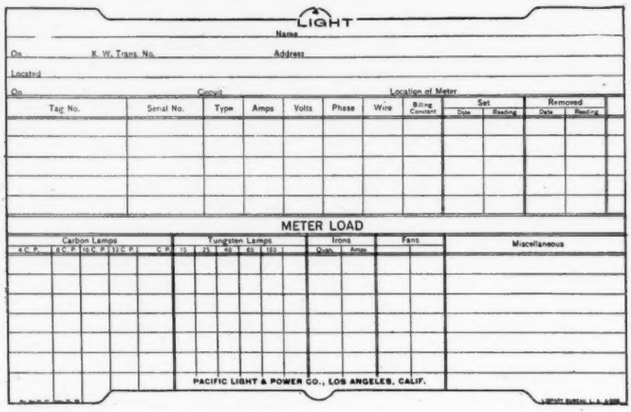


Fig. 12*a*. Information on Circuits, Meters and Meter Load

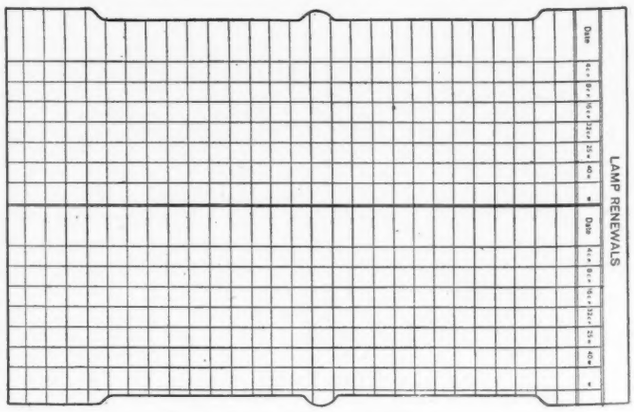


Fig. 12*b*. Lamp Renewals

A Heavy Blooming-Mill Engine

By Edward T. Child

Description of an exceptionally heavy angle-compound Corliss engine which drives the blooming-mill at the plant of the Pittsburgh Steel Co.

This engine frequently develops more than 7000 hp.

The engines driving the blooming and billet mills of the Pittsburgh Steel Co., at Monessen, Penn., exhibit a number of interesting features.

The engine room is a separate building completely cut off from the mill by a steel and glass partition, and is thus kept as clean as any electric station. The several mills are driven by spindles reaching through the partition. The blooming mill weighs 4,000,000 lb. and was built by the Mackintosh & Hemphill Co., of Pittsburg. It reduces 24x24-in. ingots to 6⅞x6⅞-in. blooms in nine passes through the rolls. This mill is driven by a 48 and 84 by 60-in. angle-compound Corliss engine, built by the Southwark Foundry & Machine Co.

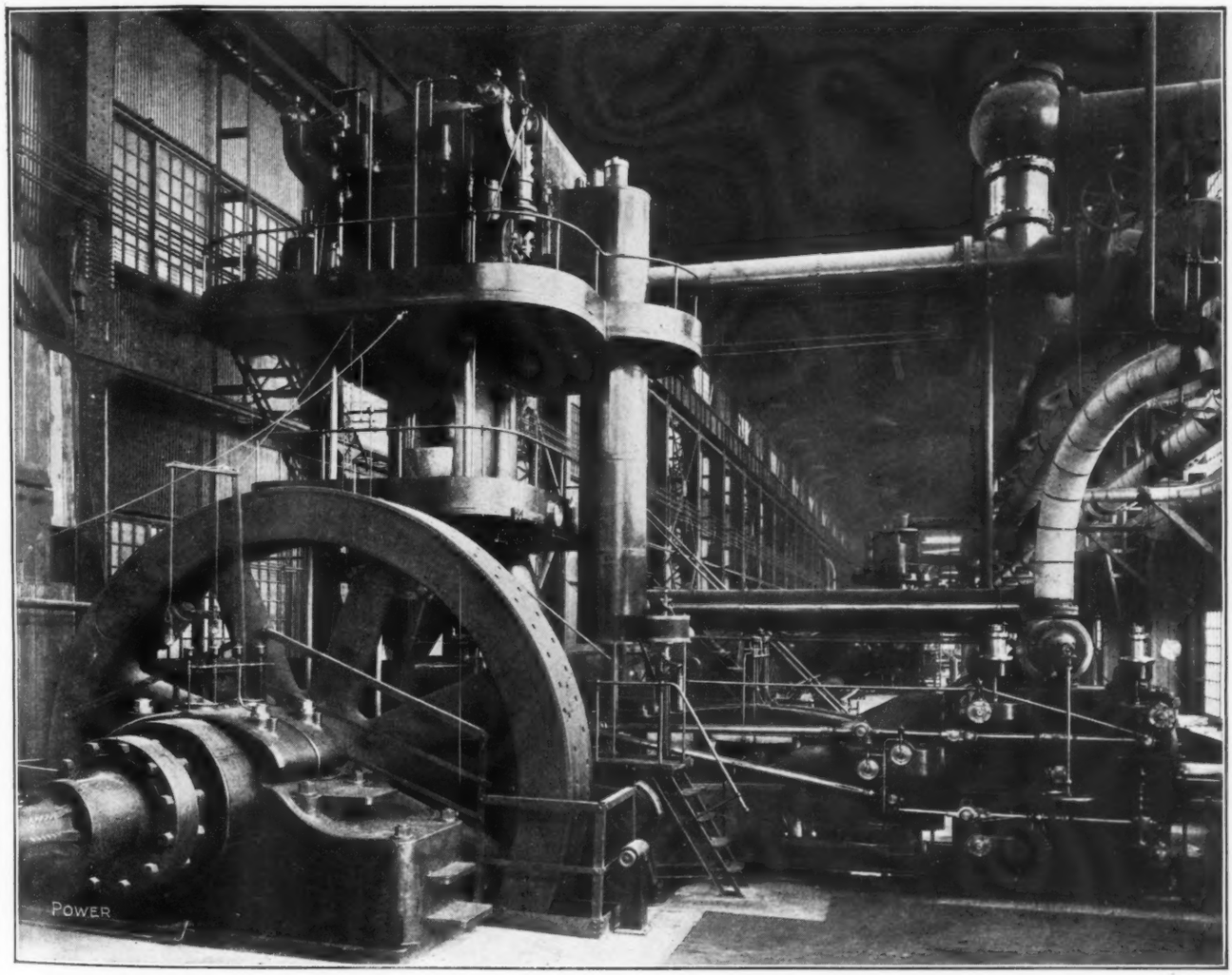


FIG. 1. ENGINE ERECTED IN STEEL WORKS

This engine is of exceptionally heavy design. Its bedplate is shown in Fig. 2, as it appeared when loaded on the special car that was necessary to transport it. This bed has guides of the four-bar type, and holds the horizontal high-pressure cylinder at one end; at the other end it supports a bell housing which carries the vertical low-pressure cylinder.

The shaft, crank and crankpin are forged in one piece, of fluid compressed nickel steel, both the shaft and the pin being hollow-forged. The former is 36 in. in diameter in the middle, reduced to 30 in. in the two bearings, each of which is 54 in. long. Since the crankpin is 24 in. in diameter, a built-up crank could not be used, for there would not have been enough metal left between the two holes in the crank. This solid-forged shaft was an exceedingly expensive feature, but the only way to avoid it would have been to have lengthened the stroke of the engine, thus not only making the cost of the engine greater, but requiring the erection of a higher building.

A distinctive feature of this engine is its valve-gear, which is shown in Figs. 3 and 4. This is of the Corliss straight-line type without wristplates, but with two eccentrics for each cylinder, thus permitting an extended cutoff. The steam valves are double-ported and of unusually large area as compared with the areas of the pistons. Very massive valve stems are carried beyond the tee-heads so as to be supported by sockets in the valves themselves. The outer ends of these valve stems are supported in spherical adjustable bearings carried by large brackets of box section. The valve

stems are thus entirely independent of the holes in the bonnets, and do not bear against the sides of these holes.

Every lever in the valve-gear is double, and the center of pull coincides with the center of support, so that there is no tendency to twist any part of the gear. There are no overhanging pins carrying a load. Consequently, no part of the valve-gear has any tendency to wear crooked, and in the clean engine room where the engines are situated, there should be very little wear at all.

The clips, being supported at both ends, are about twice as long as those usually provided on Corliss engines. With this great length, and with no tendency for the clips to get out of line, the edges wear much longer than is the case in an ordinary Corliss gear.

The engine is provided with a flywheel weighing 225,000 lb. and made in eight pieces. With a steam pressure of 150 lb. per square inch and a 27-in. vacuum, this engine frequently develops more than 7000 hp.

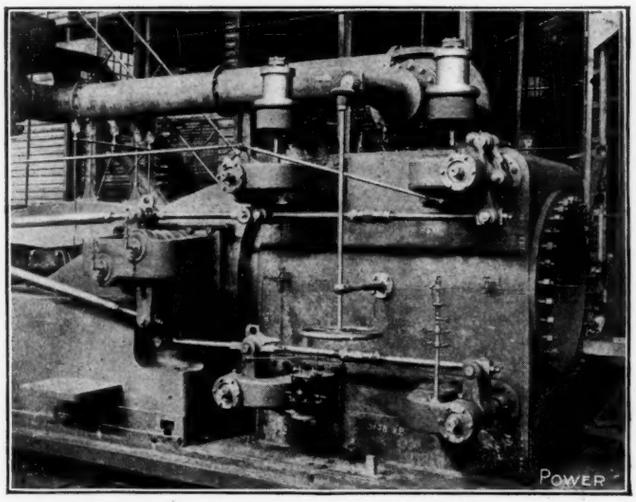


FIG. 3. HIGH PRESSURE VALVE GEAR

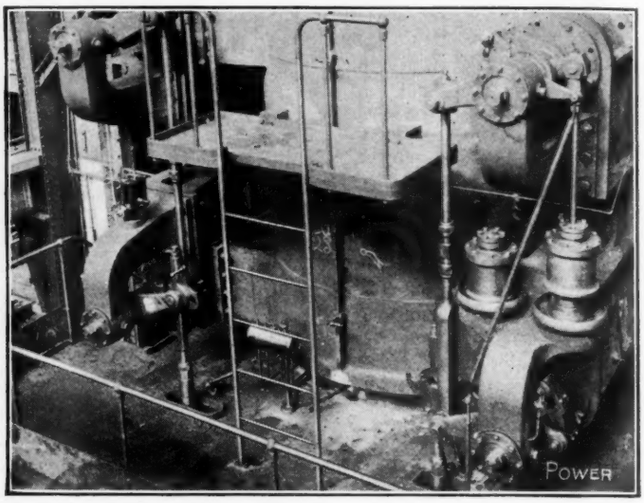


FIG. 4. LOW PRESSURE VALVE GEAR

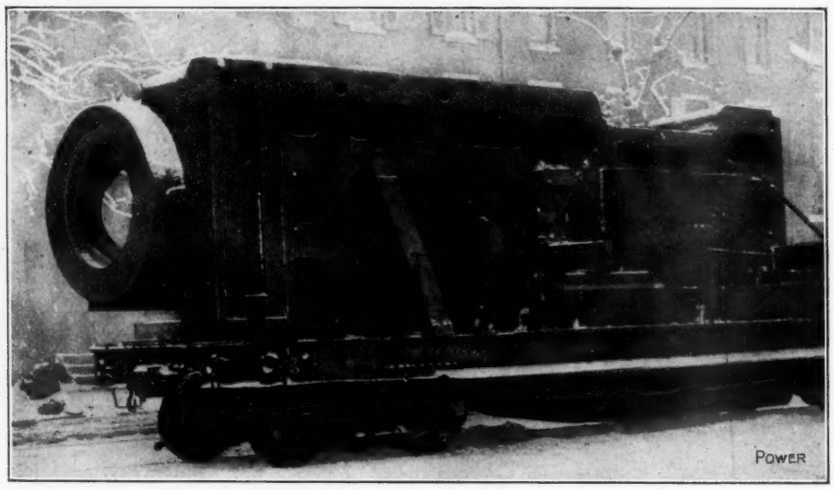


FIG. 2. BEDPLATE ON FLAT-CAR

Rate of Combustion at Different Stoker Speeds

BY D. MCGREGOR

The operation of boilers equipped with chain-grate stokers suggested to the writer the advisability of having some tabulated data whereby, at a glance, it can be ascertained whether the firemen are working the fires to the best advantage for the load carried. Accordingly the table herein shown was figured out on the basis of bituminous coal weighing 55 lb. per cubic foot, burning on a grate 11 ft. wide, at an economy of 2½ lb. per kilowatt, giving the pounds per square foot, and the corresponding kilowatts at five different rates of stoker travel, and at depths of fuel ranging in half inches from 4 to 9 in.

Suppose, for instance, that the grate is traveling at the rate of 2½ in. per minute, with a 6-in. fire. In the column headed "2½ in. per min." and on the line representing a 6-in. fire, will be found 28.59 lb. as the rate of combustion per square foot of grate surface, which corresponds to an output of 1512 kw. at the rate of 2½ lb. of coal per kilowatt-hour.

It will be noted that practically this same rate of combustion can be had by running at 2 in. per minute with a 7½-in. fire, at 3 in. per minute with a 5-in. fire, or at 3½ in. per minute with a 4½-in. fire, and it becomes the duty of the engineer in charge to decide which rate is the most efficient. This can best be decided by a careful study of the character of the coal and of the ash discharged from the grate, together with the analysis and temperature of flue gases and the regulation of draft.

From this table has been deducted the following rule for finding approximately the rate of combustion: *Multiply the depth of the fire less ½ in. by twice the rate of feed in inches to get the pounds per square foot.*

POUNDS OF COAL PER SQUARE FOOT OF GRATE SURFACE AND EQUIVALENT KILOWATTS AT 2½ LB. PER KILOWATT-HOUR

Thickness of Fire, Inches	Speed of Grate				
	1½″ per min. 7½′ per hour	2″ per min. 10′ per hour	2½″ per min. 12½′ per hour	3″ per min. 15′ per hour	3½″ per min. 17½′ per hour
4	(603) 11.44	(805) 15.27	(1008) 19.09	(1210) 22.88	(1360) 25.70
4½	(680) 12.89	(907) 17.18	(1134) 21.47	(1360) 25.74	(1530) 28.92
5	(757) 14.30	(1010) 19.09	(1260) 23.84	(1510) 28.60	(1700) 32.13
5½	(834) 15.73	(1112) 21.00	(1386) 26.22	(1660) 31.46	(1870) 35.34
6	(911) 17.16	(1214) 22.91	(1512) 28.59	(1810) 34.32	(2040) 38.55
6½	(988) 18.59	(1316) 24.82	(1638) 30.97	(1960) 37.18	(2210) 41.76
7	(1065) 20.02	(1418) 26.73	(1764) 33.34	(2110) 40.04	(2380) 44.97
7½	(1112) 21.45	(1520) 28.64	(1890) 35.72	(2260) 42.90	(2550) 48.18
8	(1219) 22.88	(1602) 30.55	(2016) 38.10	(2410) 45.76	(2770) 51.40
8½	(1296) 24.31	(1714) 32.46	(2142) 40.47	(2560) 48.61	(2940) 54.62
9	(1373) 25.74	(1816) 34.37	(2268) 42.85	(2710) 51.48	(3110) 57.83

Figures in parentheses indicate load in kilowatts.

Closed Heaters, Surface Condensers

By Edward T. Turner

A chart for readily calculating the necessary surface in a surface condenser or closed heater, when the initial and final temperature differences between the steam and water are known, also the amount of circulating water.

The engineer is frequently confronted with the problem of determining the proper tube surface in a closed feed-water heater or a surface condenser. Although there are a number of empirical formulas used for this purpose, the results obtained by them are not consistent under all conditions of temperature of steam and water. The heat transmitted through the tubes is affected, among other things, by the material of which the tubes are composed, the size of the tubes, velocity of the water through or around the tubes, the period of contact between the water and the tubes, the temperature of the steam, temperature of the water into and out of the tubes, and the quantity of water used.

Regardless of all the variable quantities entering into the design of a heater or condenser, there is one law which can be depended upon, namely, the heat transmitted through the tubes is practically proportional to the mean temperature difference between the steam and the water. However, few experiments have been made to determine the quantity of heat transmitted per hour per degree mean difference in temperature between the steam and the water under the actual conditions met with in practice. A fair assumption for this factor, and one which is found to be about right in practice, is 300 to 350 B.t.u. per hour.

The curves shown on the accompanying chart are based upon the following:

Let

T = Temperature of the steam in the heater or condenser;

T_1 = Temperature of the entering water;

T_2 = Final temperature of the water;

d_1 = Initial temperature difference between the steam and the water;

d_2 = Final temperature difference between the steam and the water;

d_m = Mean temperature difference between the steam and the water;

Q = Weight of water in pounds per hour;

F = Square feet of tube surface per pound of water;

A = Total tube surface in square feet;

H = Heat transmitted through the tubes per degree mean difference in temperature between the steam and the water (in these calculations 300 B.t.u. is assumed).

The heat transmitted through the tubes is equal to the heat absorbed by the water.

Heat transmitted through the tubes $= A \times 300 \times d_m$ (1)

Heat absorbed by the water $= Q\,(T_2 - T_1)$ (2)

Equating (1) and (2),

$$A \times 300 \times d_m = Q\,(T_2 - T_1)$$

or

$$F = \frac{A}{Q} = \frac{(T_2 - T_1)}{300 \times d_m}$$

But

$$d_m = \frac{T_2 - T_1}{2.3 \log.^* \frac{d_1}{d_2}}$$

Therefore,

$$F = \frac{(T_2 - T_1)}{300\,(T_2 - T_1)} = 0.00767 \log. \frac{d_1}{d_2}$$

$$2.3 \log. \frac{d_1}{d_2}$$

or

$$F = 0.00767 \log. d_1 - 0.00767 \log. d_2$$

Plotting F as ordinates and $\log. d_1$ as abscissa, for various values of d_2, a series of parallel curves is obtained with a slope equal to 0.00767.

To use the curves, first calculate the initial temperature difference between the steam and the water, and locate this point on the abscissa. Next, move vertically to the slanting line which represents the final temperature difference between the steam and the water and horizontally to the scale at the left, showing the square feet of tube surface required per pound of water run into the heater or condenser per hour. Then to obtain the total tube surface required, multiply this constant by the quantity of water to be used per hour.

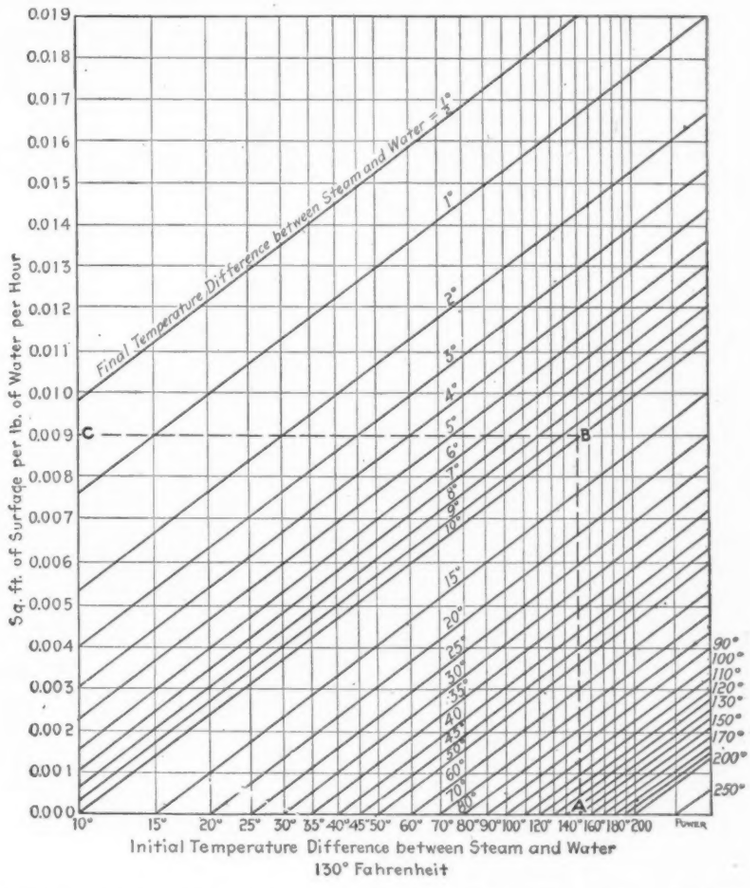


CHART FOR DETERMINING THE AMOUNT OF CONDENSING SURFACE REQUIRED

EXAMPLES

Determine the tube surface required in a feed-water heater to heat 30,000 lb. of water per hour from 62 to 202 deg.

*Common logarithms.

with steam at 15 lb. pressure, absolute. In this case the initial temperature difference between the steam and the water is 150 deg., and the final temperature difference between the steam and the water is 10 deg.

Locate 150 on the abscissa, as at *A*. Move vertically to the slanting line marked 10, as at *B*, then horizontally to the scale at the left; this shows a constant of 0.009. Multiplying 0.009 by 30,000 lb., 270 sq.ft. is obtained as the required tube surface.

Again, assume that it is desired to find the tube surface in a surface condenser to maintain a 28-in. vacuum in a plant of 1000 boiler horsepower, when the initial temperature of the circulating water is 60 deg.; all the steam generated being condensed. The circulating water required is 940,000 lb., the initial temperature difference between the steam and the water is

$$100 - 60 = 40 \text{ deg.}$$

and the final temperature difference between the steam and the water is 15 deg.

From the diagram the square feet of tube surface per pound of water per hour is 0.0033. Multiplying this by 940,000 gives 3100 sq.ft. of tube surface for the condenser.

The tube surfaces determined by the use of these curves are for multi-current heaters and surface condensers. If the heater is the ordinary U-tube type, with the water flowing around the tubes, the surface as given by these curves should be multiplied by two.

Efficiencies in the Production of Power

By H. J. Macintire

Although decided improvements have been made within the past 25 or 30 years in the design of power-plant equipment, the fact still remains that there is considerable loss of energy between the grate and the busbars; this loss is due to incomplete combustion, radiation and conduction, cylinder condensation, friction, etc. In making a study of these losses they can best be separated into four divisions:

1. Efficiency of the boiler and furnace E_1. This is represented by the ratio of the heat given up to the water in the tubes to the heat value of the coal.

2. Thermodynamic efficiency E_2, which shows how near the actual engine approaches the ideal engine. This is represented by the Rankine cycle and is the ratio of the actual indicated work, expressed in heat units, to the heat supplied. The thermodynamic efficiency shows the maximum efficiency that can possibly be obtained with the pressure and quality limits in the problem. This loss in efficiency is unavoidable under the circumstances.

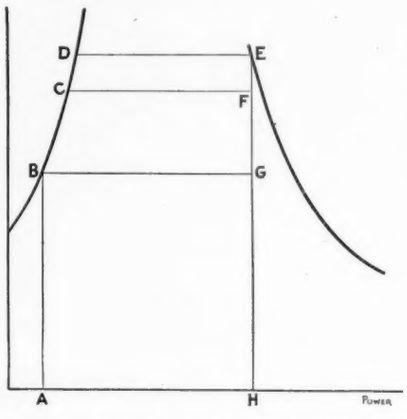
3. The next efficiency depends entirely upon the local conditions, such as cylinder proportions, steam leakages through ports, valves, stuffing-boxes, etc. This really shows how closely the engine approaches the Rankine ideal engine, which is nonconducting and in which leakages do not exist. This efficiency is equal to

$$E_3 = \frac{\textit{Efficiency of real engine}}{\textit{Efficiency of ideal engine}}$$

4. Mechanical efficiency, which is the ratio of the brake horsepower to the indicated horsepower. It varies with the design and workmanship, and in modern engines is almost independent of the load. Let this be designated by E_4.

Then the overall efficiency E is equal to $E_1 \times E_2 \times E_3 \times E_4$.

In the accompanying table of engine performances, it should be noted that the first test is the report of one about 30 years ago, while the last is but a few years ago, the others having about equal lapses of time between. As E_2 depends on the upper and the lower limits of steam temperatures, the figures show how this has increased in recent years. Referring to the entropy diagram, the heat supplied is represented by the area *ABCFGHA*, and the work done by the area *BCFGB*.



Elementary Temperature-Entropy Diagram

$$E_2 = \frac{\textit{Work done}}{\textit{Heat supplied}} = \frac{BCFGB}{ABCFGHA}$$

If the boiler pressure be increased, keeping the back pressure the same, the additional work represented by the area *CDEFC* will be performed, and

$$E_2 = \frac{BCDEFGB}{ABCFGHA}$$

which is greater than in the first case; in other words, increasing the boiler pressure or decreasing the back pressure will increase E_2. In the tests quoted there has been a decided improvement from 14.95 per cent. in the case of a simple noncondensing high-speed engine to 30.7 per cent. in the case of a 8000-kw. turbine. The value of E_3, however, is the real test of improvement. This shows the advance in making pistons and valves tight, in proportioning the cylinder diameters and stroke, in the use of steam jackets and superheat, etc. These last are all means for reducing cylinder condensation and reëvaporation.

The expression E_3 is a measure of the degree of perfection of the real engine to the ideal represented by the Rankine nonconducting engine. This ideal engine is supposed to have nonconducting pistons, cylinder heads and walls, and perfectly tight pistons, valves, packing, etc. Referring to the table, it will be seen that a gain has been made of 22.6 per cent.; that is, from 40.1 to 62.7 per cent. in the last quarter of a century. Advance in lubrication design and machine work are indicated by E_4, which has increased from 85 to 96 per cent.

The overall efficiency E is being obtained from the expenditure for coal. The increase in this factor has been from 3.32 in the first case to 13.45 in the last.

There are records of better tests, especially in the case of triple- or quadruple-expansion pumping engines having steam jackets and heaters. With all these, however, it is possible only to obtain less than one-fifth of the total amount of heat from the coal. From this it would seem that the steam engine, at its best, is a very wasteful and uneconomic appliance.

Kind of Engine	Steam Pressure Gage	Vacuum	Feed Water Temp., ° F.	Steam per I.H.P.	Superheat, Degrees F.	Efficiencies, Per Cent. E_1	E_2	E_3	E_4	E
1880 Simple, noncondensing, high speed	100	....	212	42	.....	65	14.95	40.1	85	3.32
1890 Triple-expansion jacketed condensing	160	27	100	17	.. ..	84	25.2	43.4	88	8.1
1895–98 Compound jacketed, condensing	160	26	118	13	....	77.5	24.2	46.6	94	8.24
1905 8000-kw. turbine	165	28.5	.....	10.45	125	72	30.7	62.7	96	13.4
1905 Compounding condensing engines	189.3	28	150.7	.....	92.8	83	31.2	54.9	94.75	13.45
5000-kw. plant oil fuel	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Tom Hunter, Hoisting Engineer

By W. O. Rogers

In which Hunter describes the Nicholson engine stop for preventing overwinding.

By means of this device it is impossible for the engineer to hoist when he should run the engine in the other direction.

The stop is designed to operate on shafts having several levels.

Hoisting 1200 tons of coal during a single shift is an everyday performance for many hoisting engineers. After a man has been throwing reversing and throttle-valve levers for hours at a time, it is no wonder that occasionally he gets confused and makes mistakes. It must be a good deal like trying to pat the top of one's head with one hand and at the same time perform a circular motion on the chest with the other. I put this up to Hunter one morning after breakfast and he agreed that there was a chance for confusion in signals.

"That is why automatic engine stops have been made for hoisting engines," said he. "When you come to consider that one-fifth of 1 per cent. of the total number of men employed in the anthracite-coal fields are killed, it is evident that too much attention cannot be paid to safety devices.

Record Hoisting

"While 1200 tons of coal is a good day's work, I recently read of a mine where 2840 tons of coal were hoisted 630 ft. in 7½ hours. That beats any record that I have ever heard of for a single shaft."

"Must have have had some mighty big cars," I observed, flicking the ashes from my cigar.

"The mine cars had a capacity of three tons, about the ordinary size, which means that for the entire 7½ hours of working time, the cars had to be dumped at the rate of two a minute, or one every 30 seconds. Maintaining this speed means that the cage must, through 7½ hours, travel 1260 ft. every 60 seconds, and stop twice, once to take on a loaded car and at another time to dump that car. Including the stop, the traveling speed of the cage must be 21 ft. per second in the shaft; excluding the stop, it must be twice that amount, which is going some."

"I don't see how the loaded and unloaded cars are taken off the cage at such a speed," I said. "It is so near being an automatic operation that I should suppose there would be an accident."

"There are accidents," replied Hunter, "lots of them. You see, one motion will both move an empty off and put a loaded car on the cage. In fact, as the cage checks its speed before stopping completely at the bottom of the shaft, the loaded car is set in motion. Thus, instantly the cage comes to a standstill, the loaded car moves into place, throwing the empty one off on the opposite side.

Danger from Fast Work

"That is where the danger comes from such fast work. The fact is, the signal is given to hoist before the cage has reached the bottom of the shaft. The footmen figure that the loaded car can be pushed onto the cage while the engineer is shifting his levers and getting started again. If the footmen have been slow and the car is but part way on when the cage starts, it is caught between the bottom of the cage and the top of the parting roof. Then something is going to smash. In the case I have in mind it would have been found that a single car can be caged, hoisted 630 ft., then dropped and returned to the shaft bottom in 20 seconds, which, if duplicated over and over again, means that three cars could be hoisted in one minute instead of two, and that means nine tons of coal a minute instead of six."

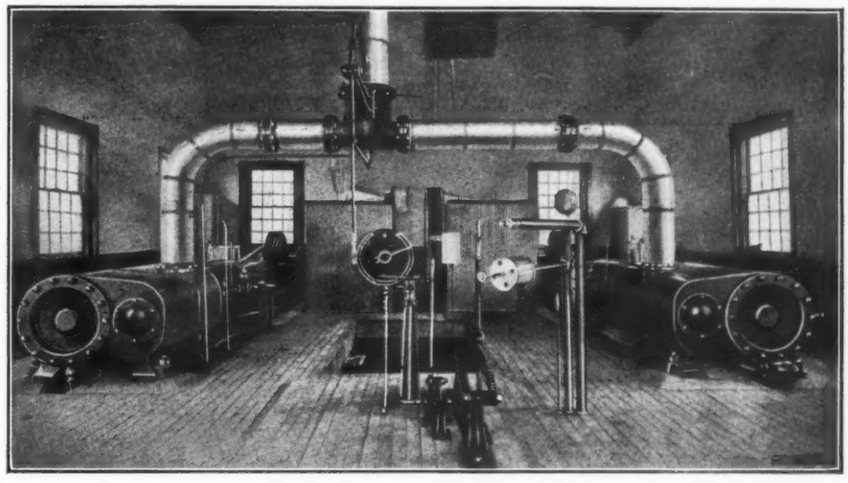


Fig. 1. Showing Engineer's Operating Levers

Want More Work

"That is going some for a fact, but I'll venture to say the owners of that mine are not satisfied with the fast work of their men, and that they will soon be looking about for ways and means of increasing this record output." I said this more from my knowledge of the way most good and willing workers are usually treated than from any knowledge of coal mining.

"Sure they will," answered Hunter. "It is simply a repetition of the biblical quotation, 'To him that hath shall be given.' It means that in most cases, and the owner of the mine now wants the men to see if they can't work a record of three cars per minute, or nine tons of coal per minute for one hour. This would mean an output of 540 tons per hour, or 4400 tons of coal for an eight-hour shift. There isn't an engineer living who could stand such going, but I have no doubt that it will be tried, and it will probably result in smashing something."

"One of these safety stops you speak of would come in handy under such conditions, I should judge," I said, as I arose and stretched myself, preparatory to taking a walk.

They Visit an Engine Room

"If you have nowhere in particular to go," said Hunter, "I'll take you to a hoisting plant equipped with one of these automatic stops, and you can see how it operates."

I jumped at the proposition, and in a short time we entered an engine room in which an automatic stop had been installed. Jones, the engineer, was a jovial fellow, and at noon time, when the engine was shut down, he took us down beneath the engine-room floor and showed us the mechanism of the device. It was a Nicholson automatic engine stop, and the engineer said that it worked to perfection. In fact, when he started up again, after dinner, he permitted it to operate, which demonstration showed the great value of the device. While examining the stop, Hunter explained its operation and construction in detail.

Nicholson Engine Stop

"The Nicholson engine stop," said he, "is constructed in two styles, that of the single-shift type for use where hoisting is done from one level, and that of the

double-shift type where tight and loose drums are used and the hoisting is done from any number of levels. It automatically adjusts itself and so removes any chance of failure on the part of the engineer to make any adjustments.

"The stop has control of the engine at each and every hoist and at any speed, and gradually cuts off the steam supply from the main or slide valve of the engine when the cage approaches the landing or dump, and so weakens the power of the engine, the slow application of the steam brake acting at the same time. It also does away with the danger of knocking the engine to pieces by continuous 'plugging,' as it is called, which is the favorite method of stopping."

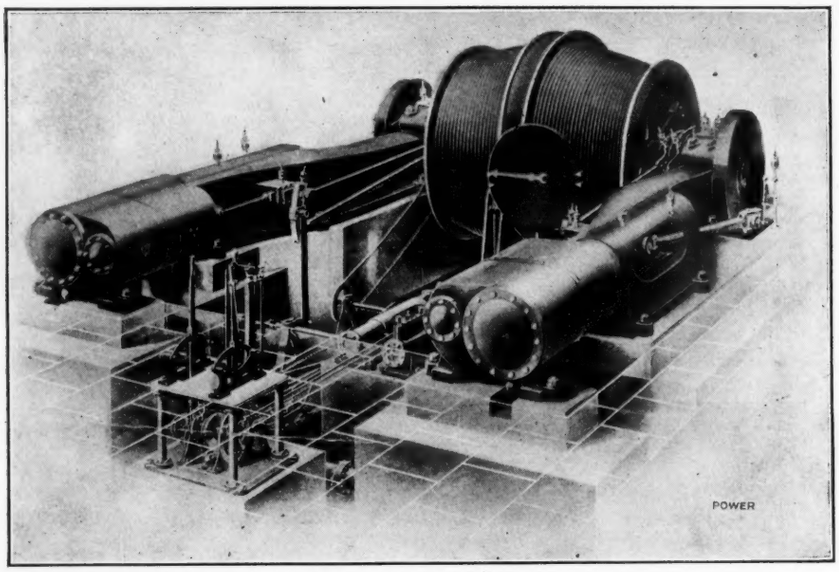


FIG. 2. SHOWING ARRANGEMENT OF ENGINE STOP UNDER FLOORING OF ENGINE ROOM

ACTS AT ANY SPEED

"Will it answer at any speed?" I inquired.

"Yes, no matter how fast or how slow," replied Hunter, "as the movement of the drum in either direction actuates the stop mechanism at a prearranged time, suitable to the hoisting conditions. The stop acts at every hoist on the main valve and does not interfere with the reversing of the engine at any time, as you might think. In fact, its action is always a positive warning to the engineer that the cage is approaching the landing, and if he is heedless of the warning by the action of the stop, the engine will be brought to a standstill before reaching the danger limit, making it necessary for him to manipulate his engine in order to reach the landing. The engineer usually has his hand on the lever in regular hoisting work, and when the lever begins to move he has warning that the cage is approaching the end of the hoist. If he fails to control the engine, because of a faulty throttle or other reasons, the stop will do it for him.

"There are cases where a speed limit is required in hoisting and provision has been made whereby it is set automatically by the stop when the increased speed limit is reached, and to automatically allow the engines to resume their normal speed again when brought under control.

ENGINEER CAN'T GO WRONG

"By the use of this stop it is absolutely impossible for the engineer to hoist up when he intends to go down, the machine having control of the engine in this respect, as the revolving disks are always operated at the danger point.

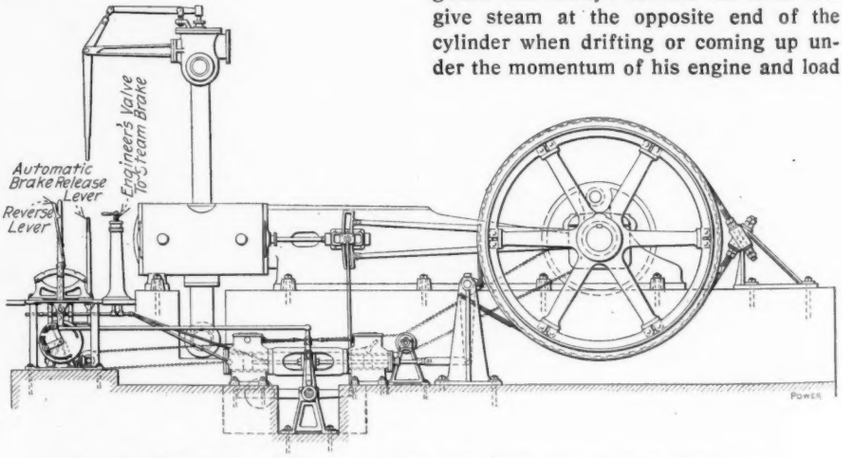


FIG. 3. ELEVATION OF ENGINE, STOP AND AUXILIARY STEAM CYLINDER

"The stop is operated by a sprocket wheel and chain, which works a worm and worm gear, and is arranged as shown in this sketch." And Hunter proceeded to sketch Fig. 3.

I afterward obtained photographs of the device, which are shown in Figs. 2, 4 and 5. By referring to the illustrations, Hunter's explanation will be easily understood.

"On the ends of the wormwheel shaft is a disk having two adjustable springs which press tappets (Fig. 4) against the face of the disk. These tappets are placed at a position equal to the travel desired. The tappets and disk revolve in either direction and come in contact with the extended end of the reversing lever, which moves toward the center of the quadrant. This hooks up the links of the engine and brings the steam valve to the cutoff position, thus closing the steam ports of the engine. At the same time the brake mechanism works in unison with the cutting off of the steam. The tappets are held against the reversing lever, and it can only be operated in the opposite direction."

"You mean that the engine cannot be started to hoist again until the link motion has been changed, and the engine run in an opposite direction to the first motion of rotation?"

"Just that. It is impossible for the cage to go up when it should go down. Under this shaft there is a disk for operating this steam valve, which shuts the brake slowly and takes up the momentum of the drum before the final application of the brake. This is adjusted so as to bring the engine to a stop before the danger limit is reached at either end of the hoist in case of a runaway."

ENGINEER CONTROLS THE ENGINE

"If this stop controls the engine, as you say, and as I have seen it do, I should think that it would interfere with the engineer in controlling the engine," said I.

"It doesn't," replied Hunter. "The engineer can always reverse his lever and give steam at the opposite end of the cylinder when drifting or coming up under the momentum of his engine and load to the landing, just the same as he does with engines not equipped with these stop motions."

"Well, how about lifting the cage from the fans, after it has rested upon them?" I next inquired; "there has to be some leeway for that."

"The mechanism is adjusted so as to

allow the engineer to lift the cage from the fans, and then reverse and go down. It works equally well when dumping cages are used. As the cage nears the curved guide it gradually slows up as the travel of the engine valve is diminished, and the steam brake gradually set for the prearranged limit of the hoist. It is only necessary to throw a lever to shut off the steam supplied to the brake. If it is necessary to give a little more valve opening after the reverse lever begins to move toward the center, a special device allows the engineer to give the engine a little more steam."

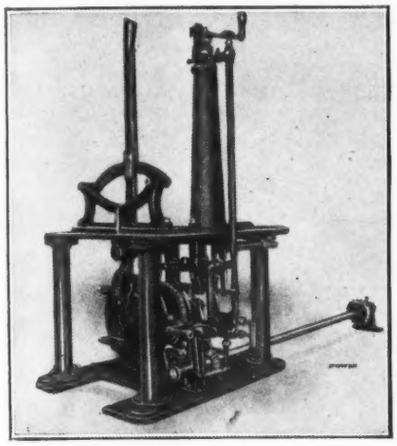


FIG. 4. DETAILS OF AUTOMATIC ENGINE STOP

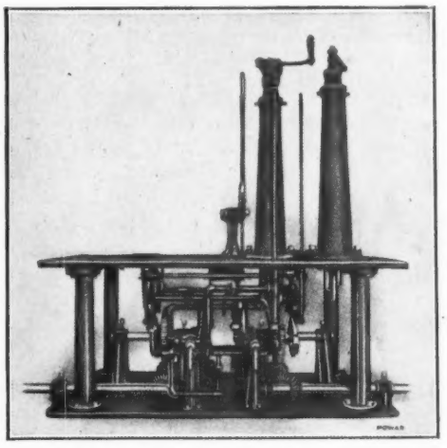


FIG. 5. STOP FOR USE WITH A NUMBER OF LEVELS

"How about the cage that is nearing the bottom of the shaft?" I asked. I did not quite understand how the stretch of the rope, due to the load on the cage nearing the top of the hoist, could be taken care of and at the same time have the stop so adjusted as to take care of the empty cage at the bottom of the shaft, which had practically no stretch in the rope.

"Well," laughed Hunter, "the rope on the empty cage will be the same on both sides of the hoist, so if the rope on the loaded car is stretched more than that on the empty car, the conditions will be reversed on the next trip. For that reason the cage will always reach the bottom of the shaft at the same time the engine is stopped."

A GOOD INVESTMENT

"Of course, that is so simple I wonder I did not think of it before. It seems to me that there are so many accidents to hoisting machinery that it would be a safe investment to install a stop on every hoisting engine at the mine, whether used on shaft or slope work."

"Well, I've seen smashes that would take considerably more money to repair than an engine stop would cost, but it is a good deal like locking the stable door after the horse has been stolen. Some people do not learn by experience. They seem to think that all of the accidents will occur with the other fellow, and act surprised when something happens to their own outfit. You know some men are called 'lucky.' People have applied that term to me, but I do not consider it as luck at all; it is merely the result of forestalling accidents by removing the cause as far as possible by using safety devices, keeping the machinery in repair, and watching for weak spots and defects. One can learn a whole lot by noting the causes of accidents to others, and then looking over his own plant to see if the same condition exists there."

ANOTHER SMASH

We finally bid good-by to Jones, the engineer, and, jumping on a passing trolley, were soon back at the hotel. Picking up an evening paper, I saw the headlines, "Engine Gets Away from Engineer. Head Work Demolished, Three Men Killed." "Another instance of useless slaughter, when a simple little device would have prevented it," I whispered under my breath as I entered the elevator and went to my room.

A Modern Pumping Plant in Mexico

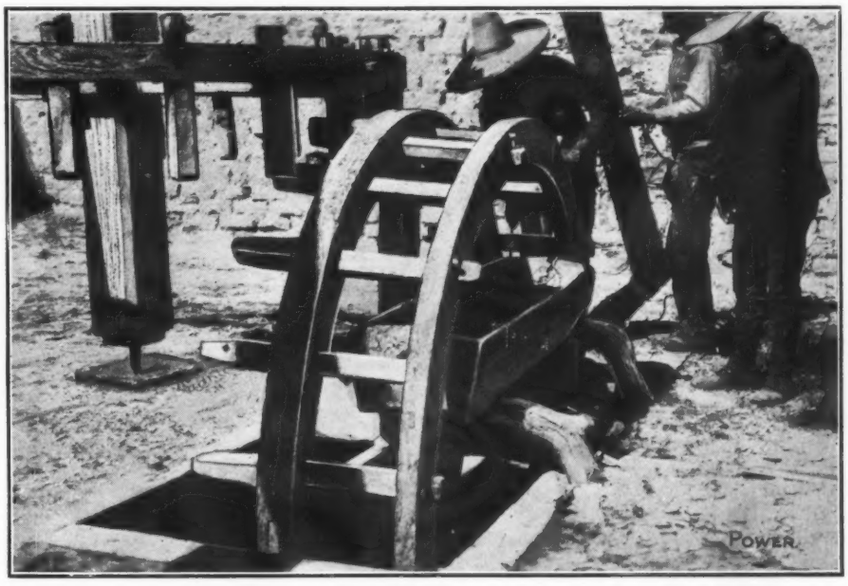
BY KIRBY THOMAS

Herewith is shown a view of a "modern pumping installation" in Mexico, which device is intended to raise water about 60 ft. Power is derived from a mule attached to a sweepstake that is direct-connected to the horizontal drive wheel. Note the "accuracy" of the meshing between the drive wheel and the vertical load carrier.

A double rope arrangement with leather buckets of about 2 gal. capacity each passes over the vertical drum wheel and empties the water when at the top of the wheel into the wooden trough, which is set under the rim of the drum, by an arrangement of the spokes on the side.

This "installation" is new, but it is an exact duplication of another pumping equipment on the same *hacienda* which bears on the rock work of the building the date 1787, and a later inscription, "remodeled 1830." The longevity of the device is thus attested to authentically.

This "modernism" in mechanics is in sight of a trunk line of railroad and near one of the large cities of the northern part of Mexico.



MODERN PUMPING PLANT IN MEXICO

Swedish water-power developments in 1911 were increased some 80,000 hp. Of this increase, 70,000 hp. was made available by privately owned plants and 10,000 hp. to the state-owned Trolhättan plant.

Results from Burning Screenings

By J. F. Mowat

Showing the highly satisfactory results of burning screenings with the aid of a balanced draft.

Screenings were formerly not only useless but entailed much expense for their disposal.

It is the purpose of the writer to show what may be accomplished with a very low-grade fuel, when conditions are kept right. In this case the fuel was byproduct coke breeze, or screenings, containing nearly 20 per cent. of moisture and having a heat value of less than 10,000 B.t.u. as fired. In addition to this handicap, the fuel was so small that it was impossible to burn it under ordinary conditions, much of it looking like dirt, and the greater part would have passed through a $\frac{3}{16}$-in. screen.

The prevailing opinion has been that it is as easy to burn sand as this kind of fuel, until it was tried with a balanced draft. The results obtained are encouraging, as this byproduct can now be burned with economy when heretofore it has been considered worthless.

The boiler tested was a Stirling and the balanced draft was had by sealing the ashpit and forcing air into it with steam blowers; then regulating the damper until the pressure in the combustion chamber was zero. The pressure in the ashpit, corresponding to a given steam pressure at the blowers, was determined by the rate of firing. That is, the harder the boiler was forced, the greater was the steam pressure required at the blowers. A 6-in. bed of fuel was maintained by frequent light firing. Every two or three minutes the fire was stirred up on top and leveled off. This treatment, which was found essential to satisfactory operation, exposed new surfaces of the coke to the air, and hastened combustion. It was necessary to clean the fires every two hours, but as no cold air was drawn into the furnace, there was little loss from this source.

The remarkable part of these tests was the large amount of water evaporated and the ease of regulating the air supply. As will be seen, the boiler during the two tests developed 141.1 and 153.4 per cent. of its rating, with efficiencies of 54.31 and 53.48 per cent., which, considering the poor grade of fuel and the high rate of evaporation, are good; and are largely because the excess air was kept at a minimum. During the first test it was 52 per cent. and at the second only 31 per cent. Another factor in maintaining the efficiency was that, due to the balanced draft, no cold air was drawn into the boiler during the frequent cleanings. With so many, the cooling effect would have been undesirable, had natural draft been used.

It seems probable that satisfactory results might be attained by applying this method to burning low grades of slack coal, as there is little trouble with clinkers, as the body of the fire is undisturbed during leveling, and the steam from the blowers keeps the clinkers soft.

The following are the observations and results of the tests, the amount of steam used by the blowers, which was determined by actual trial, being deducted.

The water was measured in calibrated barrels, the fuel was weighed on platform scales that had been tested just before the boiler tests, and all the instruments used were calibrated. The tests were run by the alternate method.

RESULTS OF BOILER TESTS

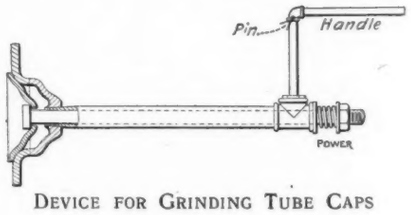
	First	Second
Kind of boiler		Stirling
Duration of tests, hours		8
Water heating surface, sq.ft		3080
Grate surface, sq.ft		62.4
Ratio of water-heating surface to grate surface		49.4:1
Average Pressures and Temperatures		
Steam pressure by gage, lb. per sq.in	100.3	114.6
Draft in furnace, inches of water	0.00	0.00
Draft in stack, inches of water	0.643	0.750
Pressure in ashpit, inches of of water	0.877	0.972
Temperature of stack gases, deg. F	590	646.0
Temperature of feed water, deg. F	48.5	47.2
Temperature in calorimeter, deg. F	245.9	260.9
Steam pressure at blowers, lb. per sq.in	94.3	101.8
Fuel		
Total weight of coke breeze fired, lb	22,901	24,089
Moisture in coke, per cent	19.37	18.09
Total weight of dry coke, lb.	18,465	19,731
Total weight of refuse, lb	4,602	3,961
Per cent. of refuse	24.92	20.08
Total weight of combustible, lb	13,863	15,770
Dry coke consumed per hour, lb	2,308	2,466
Dry coke consumed per sq. ft. of grate per hr., lb	36.98	39.52
Water		
Total weight of water pumped into boiler, lb	103,814	112,461
Quality of steam, per cent	98.01	98.00
Weight of water actually evaporated per hr., corrected	12,714	13,776
Factor of evaporation	1.2079	1.2116
Equivalent weight of water evaporated to dry steam per hour from and at 212 deg. F., lb	15,357	16,691
Equivalent water used per hour by blowers, assuming 50 deg. superheat, lb	359.5	386.5
Percentage of steam generated used by blowers	2.34	2.31
Net equivalent water evaporated to dry steam per hour from and at 212 deg. F., lb	14,997	16,304
Economic Evaporation		
Water evaporated to dry steam per lb. moist coke, lb	4.44	4.57
Water evaporated to dry steam per lb. dry coke, lb.	5.51	5.58
Water evaporated to dry steam per lb. combustible, lb	7.33	6.98
Net equivalent water evaporated from and at 212 deg. per lb. moist coke, lb.	5.24	5.11
Net equivalent water evaporated from and at 212 deg. per lb. dry coke, lb.	6.50	6.61
Commercial Rating		
Builders' rating, at 10 sq.ft. of heating surface, boiler horsepower		308
Commercial horsepower developed	434.7	472.7
Per cent. of builders' rating developed	141.1	153.4
Efficiency		
Efficiency of boiler and furnace, per cent	54.31	53.45
Coal Analyses		
Coke:		
Volatile matter, per cent	1.76	1.61
Fixed carbon, per cent	64.77	66.14
Ash, per cent	14.10	14.16
Moisture, per cent	19.37	18.09
B.t.u., dry	11,613	12,001
B.tu., as fired	9,375	9,830
Clinker:		
Combustible, per cent	29.13	28.78
Ash, per cent	70.87	71.22
Stack gas:		
Co_2, per cent	12.60	15.40
Co, per cent	0.17	0.25
O_2, per cent	7.30	5.05
N_2, per cent	79.93	79.30
Excess air, per cent	52	31

Grinding Tube Caps

By William Dunn

The accompanying illustration shows a device for grinding tube caps of a Babcock & Wilcox boiler. All that is necessary is a ¾-in. machine bolt 12 or 14 in. long, threaded 4 or 5 in. at the ends, and a piece of 1-in. pipe tapered to fit the bolt hole in the cap. A spring and nut are used to get different tensions while grinding the cap with emery and oil. If the header is hot, machine oil should be used; if cold, use kerosene.

My idea is to have the caps ground on their respective seats; then coat with graphite and cylinder oil. One should be sure to cover the whole seat with this preparation as it will keep the exposed portion of the seat from wasting away. I prefer to use cylinder oil for such work instead of boiler linseed oil, as the latter makes it too hard to remove the cap nut.



Device for Grinding Tube Caps

I also had experience in replacing tube caps of a Babcock & Wilcox boiler which had on several previous occasions been ground by applying them to a wooden board smeared with emery. Consequently the caps were almost ruined as the face had been beveled toward the outside edge; as a result paper gaskets had to be used to keep the cap tight.

Electrical Department

Conducted to be of service to the men in charge of electrical equipment in the power house

Transformer Connections

Single-phase transformers are more widely used than polyphase transformers, even in polyphase systems, for the reason that greater flexibility and interchangeability are thereby obtainable.

Single-phase distribution is generally used for a lighting system, but for power transmission and distribution either the two-phase or the three-phase system is usually preferable.

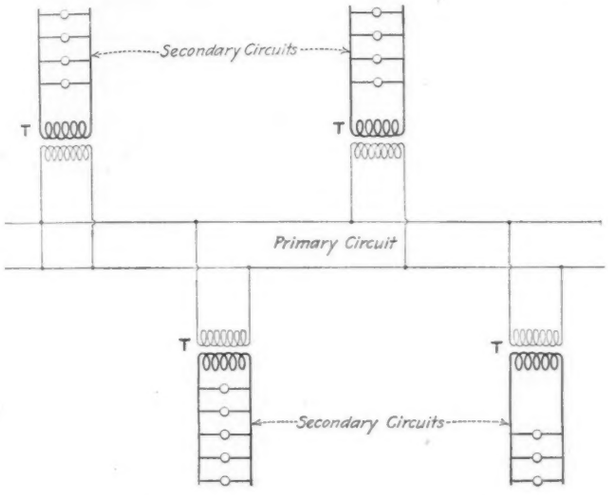


FIG. 1. SINGLE-PHASE DISTRIBUTION

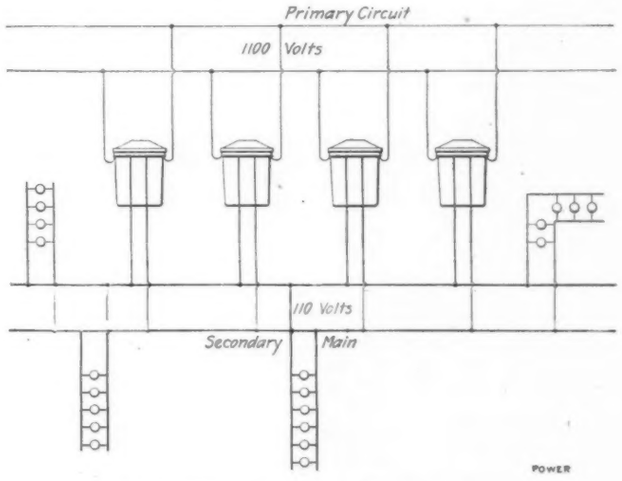


FIG. 2. FOUR TRANSFORMERS "BANKED".

SINGLE-PHASE CONNECTIONS

A typical single-phase circuit for furnishing current to lamps and motors is shown diagrammatically in Fig. 1. The primary windings of the transformers *T* are connected in parallel to the high-voltage primary circuit and the current-receiving devices are connected in parallel across the low-voltage distribution circuits connected to the secondary windings of the transformers. This system automatically maintains almost constant electromotive force in the secondary circuits and permits great flexibility of distribution from those circuits.

When a large load is concentrated at one place, the transformers may be "banked"; that is, the primary windings of several transformers are connected in parallel across the primary circuit and the secondary windings are similarly connected across the secondary circuit, the load being thereby divided between the several transformers. Fig. 2 shows four transformers connected in this way. It is preferable not to "bank" transformers, because of disproportional load division between them; when it is done, all of the transformers should be of the same make, size and type.

Transformer leads are generally connected to the windings so that the instantaneous direction of flow of the current in certain selected leads is the same in all transformers of the same type. For example, referring to Fig. 3, the transformer shown is connected inside so that when the current flows inward in the primary lead *A* it flows outward in the secondary lead *C*. Some such system is advisable in order that transformers may be readily connected in parallel; by this means it is only necessary to connect similar primary and secondary leads on different transformers for parallel operation.

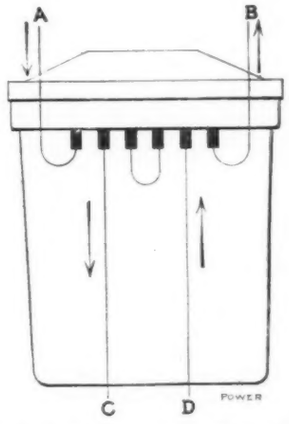


FIG. 3. INSTANTANEOUS POLARITIES

To make sure that a transformer is identical in this respect with other transformers of a different make, a polarity test is necessary. This is advisable to avoid the possibility of connecting the transformers in such a way as to short-circuit the windings. The polarity may be tested in the following manner: In Fig. 3 the primary lead *A* should be of the same instantaneous polarity as the secondary lead *C*. The primary lead *B* is connected to the secondary lead *C*, and an electromotive force of approximately 100 volts is applied to the primary leads *A* and *B*. The voltage measured from *A* to *D* should be greater than the applied voltage if the transformer is correct in polarity; if it is less, then the leads *A* and *C* are not of the same polarity, and either the primary or the secondary leads should be "crossed" if the transformer is connected in parallel with others which have the standard relative polarities.

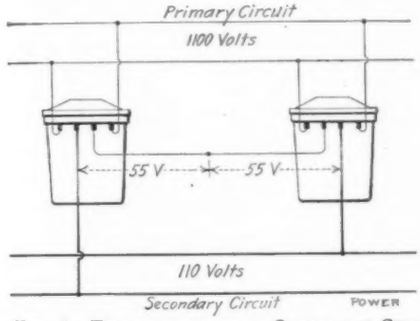
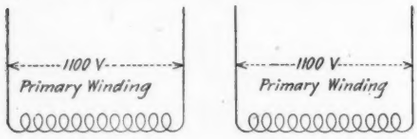


FIG. 4. TRANSFORMERS IN SERIES ON SECONDARY SIDE

Sometimes it is desirable to connect two transformers with their secondary windings in series across the distribution circuit, as indicated in Fig. 4. By this arrangement of connections, twice the secondary voltage is secured that would be obtained if the secondary windings were connected in parallel as usual. In connecting the secondary windings in series, those leads must be connected to



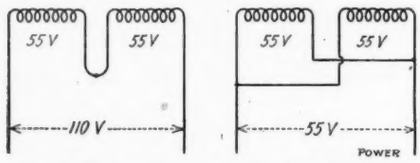


FIG. 5. SERIES SECONDARY CONNECTION

FIG. 6. PARALLEL SECONDARY CONNECTION

each other which are of *opposite* polarity at any given instant. Otherwise the two transformers will oppose each other and no secondary current will be delivered.

Transformers are usually built with the secondary winding divided into two equal sections, and some have both primary and secondary windings divided. With a transformer having a divided secondary winding it is possible to obtain either one or two secondary voltages without banking, because the sections of the secondary winding can be connected either in series or in parallel. Fig. 5 is a diagram of a transformer with two secondary windings connected in series, which gives a secondary voltage twice as high as that obtained when the secondary windings are connected in parallel as represented in Fig. 6. In connecting the secondary sections in parallel, the same precaution against short-circuiting the windings must be observed as when separate transformers are banked.

The object of providing a divided primary winding is to allow the transformer to be used on either of two voltages, one twice the other. For example, if each half of the primary winding is designed for 1100 volts, with the two halves connected in parallel, the transformer can be used on an 1100-volt primary line, and by connecting the primary windings in series the transformer may be used on a 2200-volt line.

THREE-WIRE DISTRIBUTION

In Fig. 7 two separate transformers are represented, each wound for a voltage ratio of 10 to 1 (that is, 1100 volts at the primary terminals and 110 volts at the secondary) and connected at the secondary leads so as to supply a three-wire system with a voltage of 220 between the outside conductors. The secondary windings are therefore connected in series, giving 220 volts between the outside leads. A lead is carried from the point where the secondary leads are connected together to the neutral conductor of the three-wire system, in order to obtain the secondary voltage (110) of each transformer between the neutral and each of the main wires. This method of connection gives a system which is almost the exact equivalent of the regular direct-current three-wire system. The secondary windings of the transformers correspond to the armatures of the direct-current dynamos. The only point in which similarity fails is in the voltage regulation. Both of the direct-current dynamos can be regulated, and independently of each other, but the transformer voltage cannot be regulated at all except by the use of very special, complex arrangements.

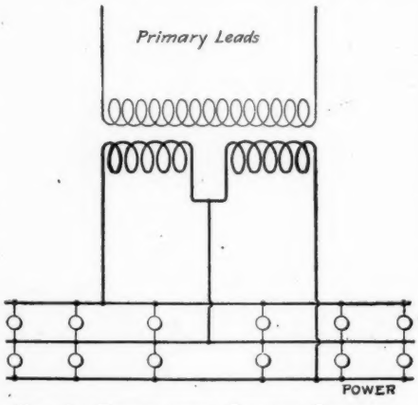


FIG. 8. THREE-WIRE CIRCUIT SUPPLIED FROM ONE TRANSFORMER

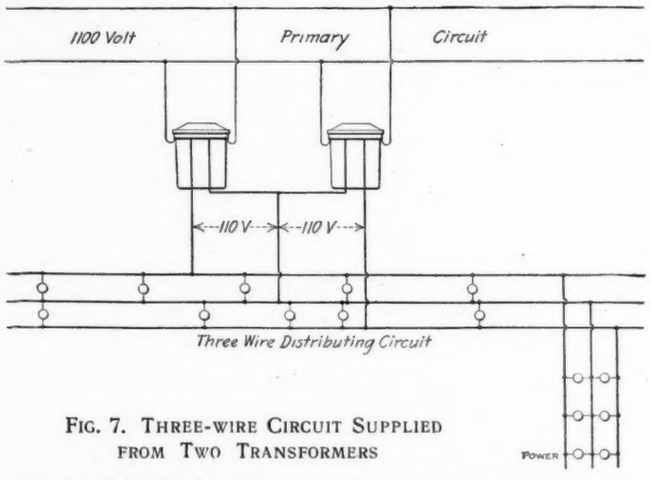


FIG. 7. THREE-WIRE CIRCUIT SUPPLIED FROM TWO TRANSFORMERS

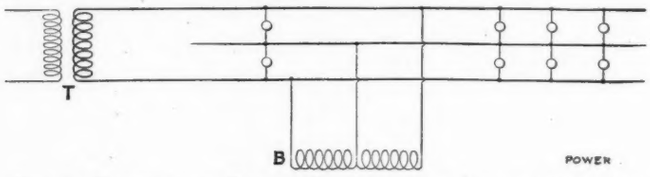


FIG. 9. THREE-WIRE CIRCUIT BALANCED BY AUTOTRANSFORMER

Fig. 9 shows still another method of connecting transformers for supplying a three-wire secondary circuit. The main transformer *T* is connected to the outside wires of the three-wire system and a balancing transformer *B* is connected to all three wires near the center of distribution. The current capacity of the balancing transformer need be only enough to carry one-half of the greatest difference in load between the two divisions of the system.

A balancing transformer for this purpose is merely an autotransformer with an intermediate tap midway between the terminals of its single winding; this tap is connected to the neutral wire, as shown. If one-half of the three-wire system is loaded more than the other half, there will be a corresponding increase in voltage drop on the heavily loaded side. The half of the balancing transformer connected to the lightly loaded side of the system will aid the half connected to the heavily loaded side and tend to raise the voltage to normal. Its operation corresponds to that of the balancing set used on a three-wire direct-current system supplied by one dynamo.

LETTER

Treatment of Commutators

My experience with small dynamos running 15 hours out of 24 has shown me that they will warm up considerably, especially if they are loaded to their capacity, and the brushes will spark if no preparation or lubricant is used on the commutator; refined paraffine is the best spark cure I have ever used. I would like to know if other engineers have used paraffine for this purpose or if anyone knows of something better?

J. E. FLASH.

Crowley, La.

Gas Power Department

Worth-while gas-engine and producer information treated in a way that can be of practical use

Dugald Clerk on the Diesel Engine

In the issue of Apr. 9 we printed an abstract of a paper which was read recently by Dr. Rudolph Diesel before the Institution of Mechanical Engineers of Great Britain. As stated in the abstract, the paper consisted largely of a historical review of the development of the Diesel engine. The discussion of the paper was opened by Mr. Dugald Clerk, the well known English authority on internal-combustion engines, who paid Dr. Diesel

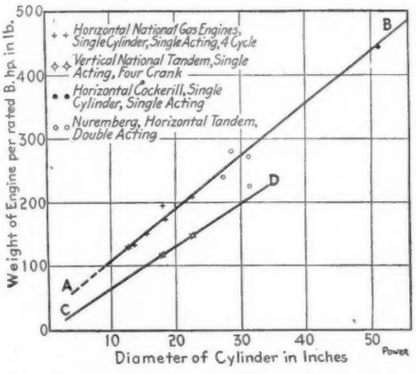

Horizontal National Gas Engines, Single Cylinder, Single Acting, 4 Cycle
Vertical National Tandem, Single Acting, Four Crank
Horizontal Cockerill, Single Cylinder, Single Acting
Nuremberg, Horizontal Tandem, Double Acting
Weight of Engine per rated B.hp. in lb.
Diameter of Cylinder in Inches
A
B
C
D
Power

FIG. 1. COMPARATIVE WEIGHTS OF DIFFERENT SINGLE-CYLINDER ENGINES

a warm tribute for his originality and his perservering struggles during the pioneer period. He regarded Dr. Diesel as one of the greatest living inventors.

Mr. Clerk then pointed out that the idea of compressing air alone in the cylinder and then injecting fuel into that air, in either a gaseous or a liquid state, was not a new one at the date when Dr. Diesel took up his work. Some twenty-five years ago (in 1887) he (Mr. Clerk) had built an engine in Birmingham of the two-stroke-cycle type, in which air was sent into the motor cylinder, compressed in the compression space, and a separate pump for compressing gas forced gas into the cylinder, this gas igniting as it entered the cylinder; this was a constant-pressure type of engine. In 1888 he had built two engines of that type. Thinking that Dr. Diesel would like to see some of the indicator diagrams taken in 1887 and 1888, he brought a few of these diagrams showing the action of the injection, and also some diagrams showing the action of the flame in the cylinder. From a running point of view the engines were very good, but as he could obtain greater economies with explosions, he had not carried the matter further. It had, however, led him to take a great interest in the theory of the constant-pressure engine.

In an early paper, contributed to the Institution of Civil Engineers in 1882, he had developed the theory of the internal-combustion constant-pressure engine very fully, and had shown the laws it was necessary to observe in order to obtain in theory the highest efficiencies possible. On the formula developed by him in 1882, and explained in his book in 1886, he had worked out the air-cycle efficiency of the Diesel engine. He had found that calculating the air-cycle efficiency of the Diesel engine from its compression space, if it lost no heat at all, and had air alone as a working fluid, the theoretical efficiency would be 0.56.

DIESEL EFFICIENCY

It appeared to him that some of the results obtained by Dr. Diesel or others for indicated efficiencies were too high. That, however, was merely a scientific criticism. He had always regarded the published indicated efficiencies of the Diesel engine as being almost all too high, for the reason that in calculating the indicated power of the engine the positive diagram above the compression was taken for the mean pressure. That positive diagram, however, included a certain proportion of work given by the high-pressure compressed air coming from the compressors. Continental engineers had considered that this was a friction loss, and should enter into mechanical efficiency computation. He differed from this view; it should not be calculated in the mechanical efficiency at all, but should be considered one of the thermodynamic elements. Calculated in that way, it would be found that the Diesel diagram would give something under 40 per cent. indicated efficiency. He could not agree that 48 per cent. indicated efficiency had ever been obtained; it did not in the least affect brake results, but it did affect the pure thermodynamics point of view.

Taking 0.56 as the highest air efficiency, with the expansions used, then, according to a great many experiments made by English engineers, a higher economy than 0.7 could not, by theory, be obtained. Multiplying 0.56 by 0.7, the result was 0.39. Dr. Diesel had actually got the very high efficiency of about 39 to 40 per cent., but he considered as erroneous the 48 per cent. which was mentioned in the paper.

By the final method that all must ultimately take—the brake power developed for a given oil consumption and given heat units—the Diesel engines gave somewhere about 0.30.

The Carels engine in 1905 showed an oil consumption at not quite full load of 0.444 lb. per brake horsepower. From the thermal value of the oil given at the same time, he calculated a brake thermal efficiency of 29½ per cent. Then the indicated thermal efficiency came out as 38½ per cent.—a very notable efficiency. In 1908 an American Diesel engine gave 29.2 per cent. brake thermal efficiency, while another gave 28.1. Recent tests of Mirrlees engines, made at Stockport, gave 31½ per cent. He thought he might say that the usual maximum brake thermal efficiency of a Diesel engine ranged from 29 to 32 per cent.

COMPARISON WITH GAS ENGINES

Mr. Clerk then stated that from any good gas engine with a compression ratio of about 5½ it was possible to get, in brake horsepower, 30 per cent. of the heat given to the engine cylinder with any form of gas; as much as 35 per cent. might be got—supposing the mixture were not compressed high enough to preignite. If, however, certain little precautions were taken, such as putting in a little exhaust gas (as he had often

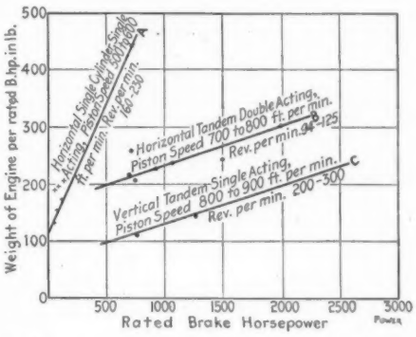

Horizontal Single Cylinder, Single Acting, Rated Speed 300 to 250 ft. per min. Rev. per min. 180-250
Horizontal Tandem Double Acting, Piston Speed 700 to 800 ft. per min. Rev. per min. 94-125
Vertical Tandem Single Acting, Piston Speed 800 to 900 ft. per min. Rev. per min. 200-300
Weight of Engine per rated B.hp. in lb.
Rated Brake Horsepower
A
B
C
Power

FIG. 2. COMPARATIVE WEIGHTS OF DIFFERENT TYPES OF ENGINE

done), efficiencies up to 33 per cent. and 34 per cent. might be reached and maintained. No commercial gas engines, however, gave 34 per cent., because the compression was a little too high and required the use of carbonic-acid gas to keep down preignition. About 32 per cent. was the regular thing.

He differed from Dr. Diesel in thinking that there was any special efficiency from a thermodynamic point of view in

the Diesel type of engine. The great advantage of the Diesel engine did not lie in that. He said he would undertake to build a compression engine with an expansion sufficiently long to give any thermal efficiency, either indicated or brake, which Dr. Diesel might get with his type; he would use the explosion type and leave the other to Dr. Diesel. To carry out such a proposition, however, it would be necessary to make a very much heavier engine than he was accustomed at present to build. As Dr. Diesel had said, the Diesel engines were much heavier than the ordinary type; bearing the weight of 500 lb. to 600 lb.

TABLE I. WEIGHTS OF LARGE CONTINENTAL GAS ENGINES OF THE TANDEM DOUBLE-ACTING FOUR-STROKE TYPE

B.hp.	Net Weight of Engine with Fittings, without Flywheel	Net Weight of Flywheel	Weight of Engine per B.hp.	Weight of Flywheel per B.hp.
	tons	tons	lb.	lb.
2000 ..	266.5	....	298.5	....
1500 ..	162.3	34.5	242.5	51.3
1060 ..	109.3	....	231 0	....
1000 ..	120.0	....	269.0	....
950 ..	95.1	25.0	224.0	58.8
800 ..	85.0	....	238.0	....
750 ..	68.5	17.7	204.5	52.6
700 ..	81.7	15.7	261.0	50.2
630 ..	66.5	....	237.0	....

in mind, he presented in Table 1 particulars of a number of Continental engines, varying from 237 lb. per brake horsepower at 630 hp. up to 298 lb. at 2000 hp. [The figures for the 750-hp. engine appear to be inconsistent.—EDITOR.]

A characteristic of the gas engine, he said, is that as the cylinder diameter is increased there is an increase in weight per brake horsepower. The diagram reproduced as Fig. 1 herewith shows this characteristic plotted in the case of a number of recent horizontal single-cylinder gas engines. The points represent different makes of engines; at the top right-hand corner a point represents one of the great Cockerill engines, with 51¼-in. cylinders. This engine weighed 440 lb. per brake horsepower. A new "National" vertical tandem, with a 22-in. cylinder, weighed 110 lb. per brake horsepower; this engine was represented on the line *CD*.

In the case of single-acting engines very big weights were reached, and the weight per horsepower increased enormously. This was the reason why Dr. Diesel had found it necessary to turn his attention to the two-stroke engine, and the speaker was interested in that fact.

In Fig. 2, Mr. Clerk showed lines representing several types of engines to bring out the differences between the various types. One example showed about 440 lb. per brake horsepower. Particulars of all these engines are given in Table 2. In the case of Dr. Diesel's 800-hp. engine (he believed the power was 200 hp. per cylinder), the weight was considerably heavier than any of these, being about 600 lb. per brake horsepower. The foregoing observations, Mr. Clerk contended, showed how necessary it was to go to the two-stroke cycle; by building double-acting two-stroke engines, the weights for engines of the same speed could be reduced to 200 lb. per brake horsepower.

Dr. Diesel had managed, with great engineering ability, to go up to the 23-in. or 24-in. cylinder. But in designing the Diesel engine it was not only necessary to design for the 500 lb. per square inch in compression but also for the equivalent of preignition in ordinary gas engines. In gas engines it was usual to design for 400 lb. per square inch, and to allow an additional 120 lb. for preignition (520 lb. in all). In the Diesel engine, he understood, the design had to be not for the ordinary maximum pressure of 500 lb. but for 1000 lb.; because if, by any chance, the inlet valve got stuck, and it happened that anything went wrong while there was a charge in the cylinder and air was being compressed (as it was in 99 or more per cent. of cases with the Diesel engine), the mixture might be compressed, with the result that, unless enough metal had been provided, there might be a bad accident.

TABLE 2. PARTICULARS OF GAS ENGINES OF DIFFERENT DIMENSIONS AND TYPES

Rated B.hp. with Coal Gas	Diameter and Stroke	Stroke Bore Ratio	Revolutions per Minute	Piston Speed	Weight of Engine	Weight per B.hp.
	in. in.			ft. p.m.	tons	lb.
Horizontal "National" Gas Engines Single-cylinder, single-acting, four-stroke cycle						
57	13×20	1.538	230	498	3.33	131.0
68	14×21	1.500	230	537	4.08	134.5
85	16×22	1.375	210	500	5.82	153.5
105	17×26	1.530	190	539	9.08	193.5
125	18.5×28	1.513	180	555	9.48	170.3
150	20×31	1.550	170	567	13.20	197.7
185	22×34	1.545	160	587	17.05	206.5
Horizontal Cockerill Single-cylinder, single-acting, four-stroke cycle						
Rat'd B.h.p with Blast Furnace Gas						
800	51¼×55	1.07	75	470	160	448
Horizontal Continental Tandem, double-acting, four-stroke cycle						
800	28×34	1.21	130	736	85	238
1000	32×40	1.25	110	733	120	269
Vertical "National" Gas Engines Tandem single-acting, four-stroke cycle						
750	18×18	1.00	300	900	39	116.5
1250	23×24	1.00	200	800	83.5	149

Dr. Diesel had replied that he had not yet had time to study the matter of computing indicated efficiency and stated that Mr. Clerk's early work had been of much assistance to him in the early development of the Diesel engine.

Peat as Gas Engine Fuel

In a paper read before the Dublin Section of the Institution of Electrical Engineers, on Mar. 16, T. Tomlinson discussed as a commercial possibility the use of peat for power production on the bog, claiming two important advantages over its use as fuel off the bog: first, the peat so used need not have the water reduced below 60 per cent, and, second, the recovery of sulphate of ammonia in the process of gasifying the peat is commercially profitable under favorable conditions. The importance of the first point lies in the decrease of the cost of production, making possible a continuity of supply without expensive storage and double handling, while under the second reason, the cost of the fuel would be covered by the value of the sulphate of ammonia.

What Mr. Tomlinson regards as favorable conditions would be a continuous demand for 2000 hp. or over, a high percentage of nitrogen in the peat, a total cost of peat of a dollar per anhydrous ton, with a certainty of continuous production.

By surface drainage of the bog a possible saving in labor would be accomplished; while a more effective method would be a thorough bottom drainage of a portion of the bog cut off from the main bog, with local surface drainage of the cutoff portion. A suggested plan of testing the saving is to begin with what is known as the cut-away bog, or that part which has been left because it lay below the rim of the "containing saucer"; hence is not workable without bottom drainage. In this way the very best black peat would be available and the main and minor drains would not be of excessive depth—not more than 12 ft. in an originally deep bog.

Relying on drainage and evaporation, with protection from rain, or in a better way which might be found in actual practice, Mr. Tomlinson believes it to be possible to greatly improve the existing hand-cut peat industry and to provide fuel continuously and at low cost for industrial purposes.

With regard to the peat belt of Ireland, Mr. Tomlinson says it lies between a line drawn from Wicklow Head to Galway and another drawn from Howth Head to Sligo. The area of peat land is one-seventh the area of Ireland, equal to 3,000,000 acres or 4700 square miles. There is no part of Ireland which is beyond reach of power derived from this area. As to the value of the bogs, if they are assumed to be on the average of the same value as the Dutch bogs, 6 ft. deep, namely, $500 per acre, a total value is arrived at of $1,500,000,000.

Passing from the peat reclaiming side of the problem to its application, some particulars of the Crossley peat plant installed at Portadown will be given. The capacity of the plant is 400 b.hp., and the peat-fuel consumption, based on bone-dry fuel, amounts to 1.65 lb. per brake horsepower-hour. This figure being multiplied by the heat value of the peat gives

$$1.65 \times 8600 = 14{,}190 \textit{ B.t.u.}$$

Seeing that Crossley's guarantee with their ordinary suction gas plants using anthracite fuel, a full-load consumption not exceeding 0.8 lb. per brake horsepower-hour with anthracite fuel containing 14,800 B.t.u. per pound, giving 11,840 B.t.u. per brake horsepower, their guarantee for peat leaves a fair margin. The Portadown plant shows a saving of over $2000 per year. The following figures show the average gas analysis from peat gas obtained when using peat with 26 per cent. moisture contents:

	Per cent.
Co_2	11.4
CO	20.6
O_2	0.4
H_2	12.7
CH_4	3.5
Total combustible	36.8
Calorific value per cubic foot...140 B.t.u.	

By the courtesy of the agents for the Power Gas Corporation, Mr. Tomlinson was enabled to give the following particulars of peat gas plants erected by that company: A 20-ton per day plant erected in Westphalia, Germany, was tested under the auspices of the Minister for Agriculture of Prussia, and in consequence of the satisfactory nature of these tests a large electric central station was erected upon a peat bog 25 miles from Osnabruck. This important town of 163,000 inhabitants has shut down its steam-driven station and is now taking power from the peat gas producer plant. The gas plant is capable of gasifying and recovering the byproducts from 210 tons per day of 24 hours of air-dried peat containing 60 per cent. of moisture. The gas drives three double-acting tandem gas engines, each of 1150 b.hp. coupled to alternators running in parallel. The current is also distributed over a radius of about 25 miles.

A central station is situated near Orentano, Italy, where gas is generated and byproducts are recovered from 100 tons of peat per day. Part of the gas is used in three 500-hp. double-acting gas engines driving alternators in parallel. The current is distributed over the surrounding district, and to the town of Pontedera, 14 miles from the plant. The supply has been uninterrupted since the starting of the plant two years ago, and the results have exceeded those guaranteed by the makers. The peat used contains 1.45 per cent. of nitrogen, and yields over 112 lb. of sulphate of ammonia per ton of theoretically dry peat.

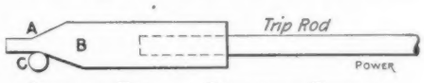
The Power Gas Corporation claims to have developed a means of mechanically drying peat from 80 per cent. moisture to 50 per cent. moisture, independent of the weather conditions, at a total cost, including excavating, drying and all handling, of about 72c. per anhydrous ton.

CORRESPONDENCE

Doing the Wrong Thing First

When an engine goes wrong the operator is supposed to get busy and find out what is the matter. That is all right, but the question is where to begin. A recent experience with a gas engine would indicate that the proper thing to do first is to find out if you have not made some mistake yourself instead of assuming that the engine is designed wrong or has been improperly adjusted by the builders.

A stationary gasoline engine undergoing a series of brake tests when handled by one squad of students had acquitted itself creditably. When another squad took it in hand, the engine started and ran all right with no load but would not carry the load it had previously carried. The captain of the squad, stating that he would "make her go or bust," got some tools and proceeded to make adjustments. He found that the exhaust valve was badly adjusted, although it was all right a few minutes before. The spark also was not timed properly, so he "fixed" that. By the time he had everything "fixed," the engine could not be started at all.



IGNITER TRIP IN STARTING POSITION

What he ought to have done was to make sure that he had made no mistake himself. In this case the mistake consisted in not advancing the spark after starting. On the end of the trip rod which actuated the make-and-break igniter there was a loose block with shoulders on two opposite sides as in the accompanying sketch. In the position shown, the block *B* is right for starting. By turning the block over so that the cam face *A* would be underneath, the inclined plane rides the pin *C* sooner than the one now in alignment, and therefore breaks the circuit sooner. He had merely forgotten to turn the block over.

R. McLAREN.

Govan, Sask., Can.

Peculiar Cause of Journal Heating

Some time ago I had charge of a 750-hp. gas engine in a cement plant. The engine was direct-connected to a line shaft from which were driven two sections of Griffin mills.

When one mill section was taken off, the main bearing of the engine would heat up in about 15 minutes and then it would take about 3½ hours to cool before the load could be put on again. So long as both sections of mills were in operation, the bearing ran at normal temperature.

After going over the engine carefully in an effort to locate the cause and without success, it was decided that the trouble must be in the mill room. Investigation there disclosed the fact that repairmen had been working on the line shaft a few days previous and had left no clearance between the collars and bearings. When one section of the mills was thrown off, the collar on the main journal of the engine would hug the bearing tightly and, being in such a position as to receive only a small amount of oil, it would heat up in a very short time. After giving all the collars on the line shaft $\frac{1}{16}$ in. clearance, no more trouble was experienced with the main bearing.

C. J. BRICKER.

Carlyle, Kan.

A "Paint" for Exhaust Pipes

After experimenting with all kinds of heat-resisting paints for our gas-engine exhaust pipes, I happened to think of a stove polish. I argued that if it would stay on a hot stove, it would on the exhaust pipes, and after a trial I was convinced I had found relief from an eyesore to the plant.

We have about 50 ft. of exhaust piping above the floor, and the burnt aspect detracted from the otherwise cleanly appearance of the plant. Anyone who has failed to keep paint on hot pipes or other surfaces will find stove polish the solution of the problem.

J. W. FRIES.

Middleboro, Mass.

Refrigeration Department

Principles and operation of ice-making and refrigerating plant and machinery

Central Refrigerating Plant at Atlanta, Ga.

By R. C. Turner

What is perhaps the largest and most modern ice and refrigerating plant in the South is the central plant of the Atlantic Ice & Coal Corporation, in Atlanta. This company operates a chain of refrigerating and ice plants extending from Richmond on the north to Jacksonville on the south, a total of seventeen plants, all of which are operated during the summer months. But out of the total number of plants operated by the company the central plant in Atlanta is conceded to be the most efficient, and on account of being a combination plate and can factory it can produce ice continuously for less than 70c. a ton.

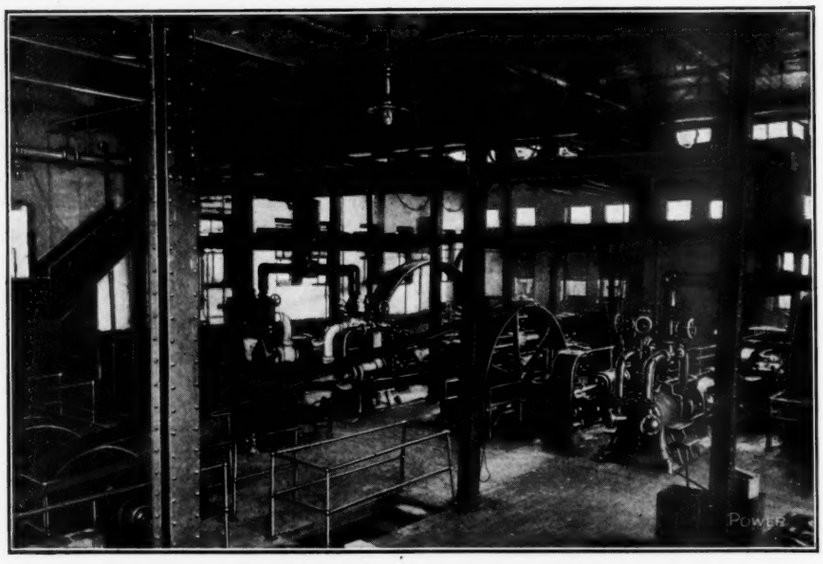


Fig. 1. Engine Room of Central Ice Plant, Atlanta, Ga.

Located at the corner of Piedmont Ave. and the Georgia R.R., the plant is afforded exceptional railroad facilities, owning a side track and coal trestle which render the icing of refrigerator cars and the delivery of the coal supply a simple and economical operation.

Refrigerating Equipment

The refrigerating machinery has a capacity of 375 tons, 24 hours' rating, and consists of the following: two 100-ton ammonia compressors direct-connected to cross-compound Corliss engines of 350 hp. rating and a third machine of 50 tons capacity direct-connected to an 18x36-in. Corliss rated at 125 hp. These three machines have been in operation during the last three years. A fourth machine is being erected at the present time and is of 150 tons capacity direct-connected to a Corliss cross-compound of 500 hp. capacity. The work of erecting the new compressor is progressing rapidly and the new unit will probably be in regular service by the first of May.

All the ammonia compressors are of the standard double-acting type with extra deep stuffing-boxes to admit of the use of metallic packing; the stuffing-boxes are also equipped with an independent expansion valve so as to insure a cool rod under severe operating conditions met with when using the flooded system.

The freezing tank, which is 50x100x 10 ft. in the plate department, and is made of standard tank steel, is equipped with 100 five-ton freezing compartments. Six days are usually required to freeze a plate weighing five tons of 10,000 lb. When a plate freezes to the desired size the ammonia supply to this particular coil is cut off and the hot gas turned into the coil to loosen up the plate of ice so that it can be withdrawn from the tank with the aid of the hydraulic crane. It is then placed on the cutting table and reduced to any size of block desired. The water in the plate tank is kept constantly agitated with compressed air during the freezing process.

In the can ice department the freezing tank is also 50x100x10 ft., and contains 1064 standard 400-lb. block cans. The freezing bath employed is a chloride of calcium solution and the expansion piping is standard extra-heavy 2-in. pipe. The agitation of the brine is accom-

Fig. 2. Freezing Tanks in Plate Ice Room

plished with a set of double propellers and is driven by a 7-hp. motor. A new tank, which will double the capacity, is now nearing completion and will be in service at an early date. A feature of this tank is that all joints in the ammonia piping are welded, reducing the leakage to a minimum. In this department electric hoists are employed to lift the cans from the bath and place them on the steam table to loosen up from the can; after this the ice slides by gravity into the storage room.

The condensers are located on top of the building and are of the single-pipe type of extra-heavy 2½-in. piping made into headers 20 ft. in height. The water supply for keeping the condensers cool and supplying the plate tank with make-up water is obtained from two 500-ft. artesian wells. The wells are equipped with the usual deep-well air lift. The water is driven out under 80 lb. air pressure, flows into a receiving tank and is circulated over the condensers by a centrifugal pump.

Power Plant

Four 150-hp. return-tubular boilers are installed and operate at 150 lb. steam pressure. The boiler equipment is being supplemented at the present time, however, by the addition of three more units of the same size and type. When the additions are completed in the boiler room this department will have a capacity of 1050 hp. The water supply for the boilers is river water from the city water-works.

The plant is equipped with three air compressors of ample size to supply the needs of the plant. One of these compressors is direct-connected to a small slide-valve engine which is used only in an emergency. The other two are driven from a countershaft which in turn is belt driven from the flywheel of the engine operating one of the ammonia compressors. To the same countershaft are connected generators which supply electric light and power for the plant.

The engines are operated condensing and are served by a set of standard surface condensers from which the condensed steam is passed direct into the supply tank of the distilled-water system; no condensation is returned to the boilers as these are at all times fed direct from the city water main.

Storage and Service

The plant has two ice-storage rooms having a combined capacity of 3000 tons. During the winter months, when the demand on the plant is at the minimum, these rooms are gradually stocked up to their full capacity. At the central plant 10 cold-storage rooms are operated for the convenience of the local fruit and produce dealers. A different temperature is maintained in each room, ranging from 10 deg. in the fish room to 34 deg. in the meat compartment.

The company also operates a refrigerating service for the convenience of the local packers and grocers who are within a radius of ¼ mile of the plant. The brine system is used; the underground pipe line supplying the service to the packers is made up of 5-in. extra-heavy pipe. For circulating the brine a centrifugal pump driven by a 5-hp. motor is used and a constant pressure of 20 lb. is maintained on the line. The temperature of the brine on leaving the pump is 12 deg. and on the return pipe of the system the temperature is usually about 10 or 12 deg. higher, being subject, of course, to the variation of the outside temperature. In the boxes at the packing houses the temperature ranges from 34 to 38 deg. The refrigerating service has been in operation for several years and has proved very satisfactory.

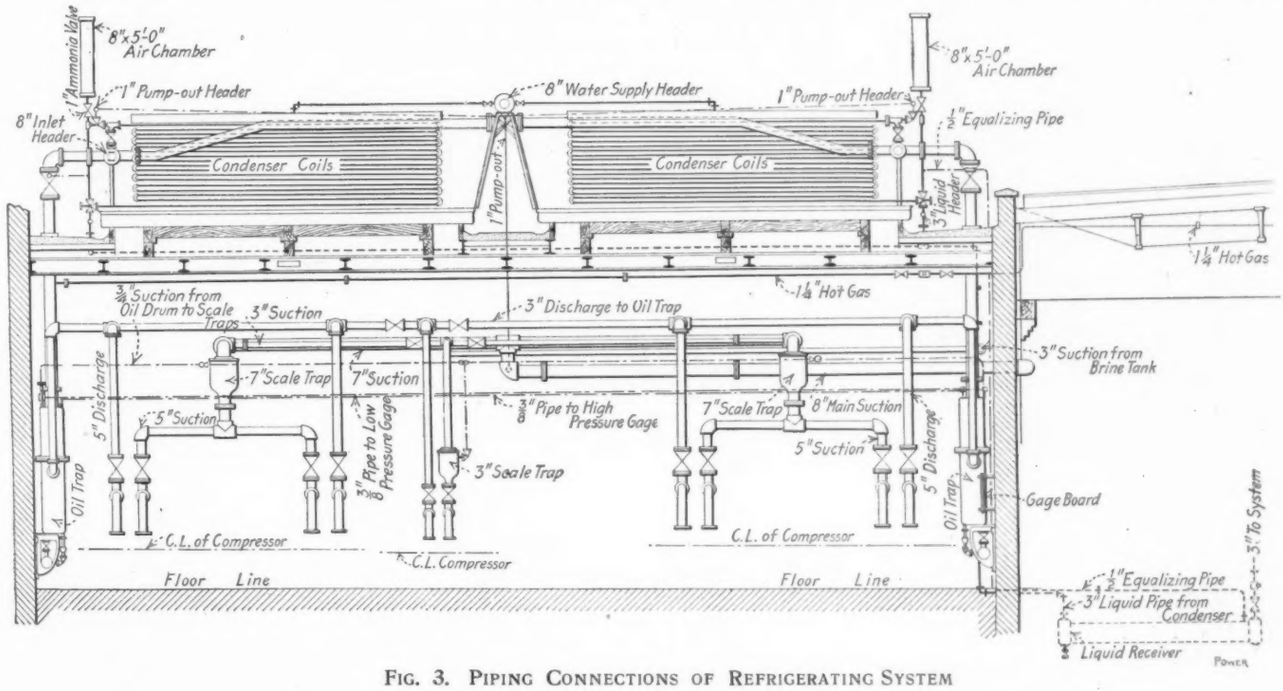


Fig. 3. Piping Connections of Refrigerating System

Plugging Leaky Tubes in Absorber

By Gay A. Robertson

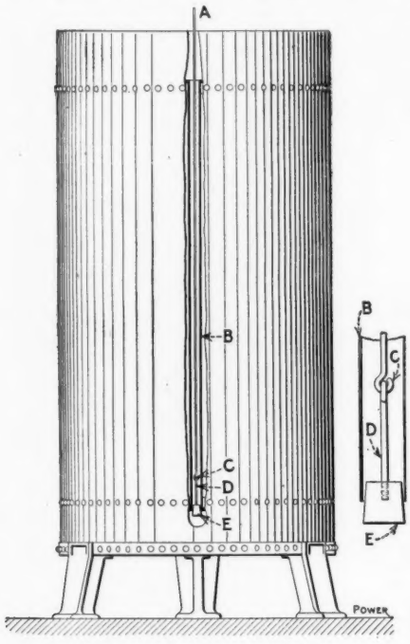
In operating absorption machines, trouble and inconvenience are often experienced by leaks in absorber tubes, where the shell type of absorber is used. This is especially true when the tubes begin to get old.

Leaks most generally come in the upper part of the tube, depending upon the height the aqua is carried in the absorber. It seems that the hot gases in connection with the hot aqua pit the tubes, possibly attacking impurities in the iron.

Troubles of this kind, of course, always happen when one least expects them, and when ice is needed most. It therefore falls upon the engineer to make a quick temporary repair and get his plant going. The accompanying sketch shows a handy method of plugging a tube, using cast-iron plugs, and a bar to assist in starting the lower plug. The sketch shows the shell of an absorber, with a 2-in. tube *B* in position; *A* is a ½-in. round iron, with the hook on the lower end at *C* to engage with the eye of the eyebolt *D*, which screws into the cast-iron plug *E*.

When a leak develops in the absorber,

the back pressure should be brought to zero at once. It is well to let cooling water run through the absorber, as long as its pressure is above zero, so that its temperature may be reduced. Then drain the water out of the absorber as quickly as possible. While doing this it is well to pump as much of the aqua as possible out of the absorber into the generator, without producing a vacuum on the absorber. As soon as the water begins to get low, loosen the bolts in the lower head, and when the water is out, lower this head so as to see and be able to get under the absorber. If there is no sign of a leak in any of the tubes, open the weak-liquor valve and let the aqua from the generator into the absorber. Have the rod *A* on top of the absorber,



METHOD OF PLUGGING A TUBE IN ABSORBER

and ready to put down through the leaky tube as soon as the aqua begins to run out.

While testing for leaks, it is well to play a stream of water under and on top of the absorber to kill the ammonia smell. Let the rod *A* down below the lower tube sheet far enough that the cast-iron plug can be hooked on. In the event that the ammonia smell is too strong, set the plug on the end of a 5- or 6-ft. plank, while hooking it onto the rod. Then jerk the plug into position in the end of the tube and play a stream of water against the lower tube sheet while driving the plug firmly into the tube. With a pipe wrench at *A*, back the eyebolt out of the plug and then drive another plug into the upper end of the tube. If the plugs are set well into position, they will stop the leak until the machine is shut down for general repairs.

These plugs, which are made of cast iron, are 2 in. in length, 2 in. in diameter at one end and $1\frac{1}{16}$ in. at the other; they are tapped for a ½-in. eyebolt in the small end.

The engineer should keep his eyes open for leaks in the absorber. Too often this is neglected and a great deal of ammonia is lost before the leak is discovered. It is the writer's practice to bring the overflow water from the absorber to an open basin located at some handy place in the engine room, where the engineer can easily observe the water as he goes about his work. Most deep-well waters will show the presence of ammonia by a white precipitate, which, of course, gives the engineer a handy check as to the condition of the absorber. In the event that a water is used which does not show a precipitate, it should be tested frequently with a few drops of phenolphthalein or Nessler solution. By no means resort to the method of, waiting until the aqua begins to disappear.

LETTERS

Temperature of Ammonia Discharge Pipe

I have read the letters under the above heading, and I think that more light on the subject might be of benefit to some of the refrigerating engineers. Here is one point that should be kept in mind.

The conditions and temperatures will be found to vary in different plants, and even in two machines of the same size and make, running under apparently the same conditions. The machines will have different temperatures in their suction pipes and different temperatures in their discharge pipes; in other words, they may seesaw first one way and then the other.

It is impossible to lay down any hard-and-fast rule to go by; a wet-gas machine might be run to best advantage with a discharge-pipe temperature of 100 to 110 deg. F., while with a dry-gas machine the discharge-pipe temperature might be 225 to 300 deg. F., or even higher, to get the capacity of the machine. Every plant should have mercury wells in the suction and discharge pipes; one in the suction line as near the point where it leaves the freezing tank as possible, another close to the compressor, and a third in the discharge pipe close to the compressor.

Use a reliable thermometer and then improve on the operating conditions until results are obtained closely approximating those given in the tables of ice-machine builders and textbooks.

The writer ran a 10-ton machine under the following conditions and got within one-quarter ton of its rated capacity: Freezing-tank temperature, 16 deg. F.; suction-pipe temperature at compressor, 40 deg. F.; discharge temperature, 440 to 460 deg. F.; condenser-water temperature, 90 deg. F.

The suction pipe was about 50 ft. long and was brought back through the sweet-water tank—a very bad practice but often found. I would be glad to hear from other refrigerating engineers.

B. E. RAMSEY.

Eureka, Kan.

Making Chloride of Calcium Brine

I have read the articles of William L. Keil and Fred Kaiser on making chloride of calcium brine. My way of making it is to cut two holes in the head of the drum in which the chloride of calcium comes; the holes to be near the edge of the head and diametrically opposite. Then suspend the drum in the water or brine to be strengthened, the upper hole to be just under the surface of the brine.

The weak brine or water will run in at the upper hole and dissolve the chloride of calcium and run out of the lower hole and sink to the bottom of the tank, as the strong brine is so much heavier. A good circulation will thus be maintained until the chloride of calcium is all dissolved. If the brine gets strong enough before all is dissolved, the drum can be hoisted above the brine until needed again.

It is better to keep the end of the drum in which the holes were bored lower in the tank than the other end, so all of the chloride of calcium will be dissolved.

In dissolving salt in bags, it is a good plan to suspend the bag in the water near the surface. The salt will dissolve without even opening the bags and even without the trouble of stirring; in fact, quicker without stirring, as the weak liquid is at the top.

DANIEL ASHWORTH.

Wappingers Falls, N. Y.

Removing Rubber Packing

I had started in to dismantle a small ammonia condenser, preparatory to putting in new water-cooling coils, when the Feb. 20 issue of POWER arrived. I found the application of W. C. Reed's pipe auger described in that issue to be most satisfactory for reaming out the rubber and lead packing around the ends of the coils. As our condenser has only three 1¼-in. coils and one 1-in. coil, I thought at first that the trouble of making an auger would be as much as digging out the packing with hooks, but after working for nearly an hour without gaining any headway, I resolved to make an auger and cleaned out all the glands in a little more time than it took me with the packing tools.

L. M. JOHNSON.

Glenfield, Penn.

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Contents

Page

Power Plant Recording System..... 646
A Heavy Blooming-Mill Engine..... 649
Rate of Combustion at Different Stoker Speeds 650
Closed Heaters, Surface Condensers 651
Efficiencies in the Production of Power 652
Tom Hunter, Hoisting Engineer.... 653
A Modern Pumping Plant of Mexico 655
Results from Burning Screenings... 656
Grinding Tube Caps..... 656
Transformer Connections 657
Treatment of Commutators..... 658
Dugald Clerk on the Diesel Engine 659
Peat as Gas Engine Fuel..... 660
Doing the Wrong Thing First..... 661
Peculiar Cause of Journal Heating 661
A "Paint" for Exhaust Pipes..... 661
Central Refrigerating Plant at Atlanta, Ga. 662
Plugging Leaky Tubes in Absorber 663
Temperature of Ammonia Discharge Pipe 664
Making Chloride of Calcium Brine.. 664
Removing Rubber Packing..... 664
Editorials 665-666
Readers with Something to Say:
Renewing Boiler Stays....What Broke the Pistons?....Lifting a Broken Plunger....Quick Pump Repair....Vacuum Caused Water-Hammer....What Forms the Clinker?....Draft Troubles....Bearing Repair....Reducing Motion Kink....Emergency Piston Repair....Eccentric Slipped....Gear Cases....Eccentric Repair....Bends for Blowoff Pipe....667-669
Questions Before the House:
A Narrow View....Power Plant Operating Costs....The Arithmetical Mean....Troublesome Feed Pump....Temperatures in Engine and Boiler Rooms....Centrifugal Pump Troubles.....670-671
Inquiries of General Interest..... 672
The Power Show at Boston..... 673

POWER

Fixing the Blame

While it is best that the Senate Investigating Committee be left to fix the blame for the "Titanic" disaster, we fully agree with the recent utterance of Rear-Admiral Alfred T. Mahan that "there are certain facts which need no inquiry to ascertain."

We know, for instance, that all the engineers and most of the stokers went down with the ship. We are just as confident that nearly all these men could have been saved if the "Titanic" had been provided with sufficient lifeboats and safety apparatus.

Because just such an accident had never happened before does not render the London Board of Trade less culpable in that it did not amend its merchant shipping acts to keep pace with the great increase in tonnage which has been made in the past eighteen years. Section 427, of the act of 1894, under which the "Titanic" was permitted to sail, required lifeboats only sufficient to care for nine hundred and sixty-two persons out of over two thousand on that vessel.

Under the German law, for instance, the "Kaiser Wilhelm II," a vessel two-fifths the size of the "Titanic," is compelled to provide for the safety of over seventeen hundred persons, the requirements being regulated by the tonnage. On this ship the entire crew is drilled once while in a foreign port and twice while in the home port. This frequency makes the duties routine, the work almost automatic and the skill so developed as to instinctively compel the men to do the right thing at the right time.

The engineers and stokers claim a large share in this safety efficiency, the engineers having command of twenty or more collapsible boats and the stokers being so trained, it is said, that they are better oarsmen and navigators than are the average sailors of some of the other lines.

While the duties of engineers and stokers make them the last to leave the ship in case of accident, the rare discipline and orderliness of the deck crews have taken care of all the others and thus make it possible for the engine- and boiler-room forces to join their own boats at the last minute.

Such requirements on the "Titanic" would doubtless have saved many of its engineers and stokers. Now that an "unsinkable" ship has so disastrously belied its name, it is to be hoped that the Board of Trade will see the necessity for bringing its shipping laws up to the standard set by Germany.

Steam Turbine and Power Plant Operation

Before the days of the steam turbine, the chief engineer had to pay very close attention to the alignment, keying-up and valve-setting of his engines in order to keep his plant in successful and economical operation. The valve-setting and adjustment were of great importance and much emphasis was laid on the taking and the study of indicator diagrams. Little attention was paid to the condensing apparatus, which was considered satisfactory so long as twenty-five or twenty-six inches of vacuum could be maintained.

The steam turbine, however, has no parts to be keyed up or adjusted, its oiling is automatic, and its economy remains practically constant in most types so long as its specified operating conditions are maintained. The factors which affect the operation of steam turbines are steam pressure, superheat or quality and vacuum. Slight changes in steam pressure have but little effect on the economy, but, nevertheless, this should be held constant to avoid forcing the boilers when the pressure drops. The superheater tubes must have the flue dust blown off at frequent intervals to maintain the desired temperature. If only saturated steam is used, dirty or foaming boilers should not be permitted and all traps from separators should be maintained in perfect operating condition.

The maintenance of the highest vacuum under the given local conditions is of the greatest importance in economical

steam-turbine operation as a decrease in one inch of vacuum increases the steam consumption about four per cent. To maintain a high vacuum the water supply to the condensers must be ample, the tubes clean in surface condensers, the piping air-tight and the air-pump valves kept free from carbon deposits resulting from unsuitable oil, and they must work properly at all times. The chief engineer should be as intimate with the mercury column on the exhaust and a pot of suitable paint to stop air leaks as he formerly was with an indicator.

Greater power is required by all condenser auxiliaries for high vacuum; hence more attention must be given to such machinery in order to secure the best economy of the plant.

Quite a field is open for investigators to study the effect of air leakage on the maintenance of high vacuum and to develop a means whereby excessive air leakage can be easily distinguished from insufficient or ineffective water supply in condensers.

In a steam-engine plant it is one of the tasks of the chief to keep an eye constantly on his engines, watching for signs of trouble and seeing that the oilers are attending to their work properly. Steam turbines do not need such close attention; hence the engineers can give greater attention to the boiler room, where the greatest increases in economy are possible. Instead of studying indicator diagrams, the chief of a turbine plant can now busy himself with problems in furnace design, in the thermal values of coal and in high vacuum work, and in this study he can derive great assistance from careful reading of the technical press.

It is thus evident that the introduction of steam turbines within the last ten years has wrought great changes in the thoughts and activities of a large number of engineers. By adapting himself to these new conditions, the uptodate engineer is preparing for the still more radical changes in power-plant operation that seem inevitable when the superior economies of the byproduct recovery gas-producer plants and of Diesel-engine equipments are properly recognized, and the time for this recognition is not far distant, judging from the strides made recently in these fields.

A Narrow View

One of our correspondents states as his humble opinion that "No engineer in an ordinary situation paying him anywhere from twelve to eighteen dollars per week has any right to purchase apparatus such as indicators, calorimeters, etc., for the use of the firm which employs him."

On the other hand, the man who owns an indicator, a calorimeter, a gas-analysis apparatus and a few good reference books and knows how to use them, will not long be working for two or three dollars per day.

Access to an indicator, an opportunity to apply it and an intelligent study of its revelations will do more for the man than it will for the firm. This is true of the other things mentioned.

It is well for the man if they form a part of the equipment of his plant and he can gain his experience with them at his employer's expense, but if he can get access to such apparatus in no other way, he will find that his own possession and use of it will pay big returns upon the necessary investment.

The man who prefers to put in his time shining bright work because the firm will pay for the paste and furnish the rags, rather than to be analyzing flue gas with an Orsat of his own, because the firm may get some benefit from it, is likely to stay in the two-dollar-a-day class.

The Inconsistency of the "Titanic" Disaster

From an engineering point of view, the greatest inconsistency of the "Titanic" disaster was that the vessel sank with forty thousand horsepower available within herself. This power was more than enough to keep the vessel afloat until all the passengers could have been transshipped to safety.

From the time the ship struck the iceberg the engines remained idle, although there was a forty thousand-horsepower equipment, which was more than sufficient for pumping out all the water that entered the hull, doing nothing. If the engines could have been quickly connected to powerful centrifugal pumps, the inrushing water could have been pumped out fast enough to keep the vessel afloat, for forty thousand horsepower will handle a veritable flood against such a low head. As it was, the huge vessel remained afloat for about three hours after the starboard side had been torn open.

Capt. C. C. Marsh, U. S. N., is experimenting with the use of compressed air to expel the water from the compartments of a disabled ship. He, however, proposes to carry the compressed air in tanks. It is difficult to see how the various compartments can be made air-tight overhead.

"Running a Steam Turbine"

Forty-six competitors responded to our offer of a prize of fifty dollars in gold for the best article on steam-turbine operation, and their articles are now in the hands of one of the judges.

When the three judges have arrived at a decision, the award will be made and the prize article published.

The contest has brought out a mass of good material, and such points as are not adequately covered in the prize article will be presented in POWER with acknowledgment to their authors.

Standard Indicator Cocks

A great deal of unnecessary trouble is caused to the users of steam-engine indicators by the different cocks and couplings used by the several makers. It is provoking to find an engine all nicely provided with cocks and reducing motion and everything apparently ready to proceed with the taking of diagrams, only to discover that the cocks are of a different standard from one's indicators and that the proceedings must be halted until the engine can be shut down and the change made, which may involve considerable complication in the case of a side pipe and three-way cock.

It would seem that whatever little advantage there may be to a maker in maintaining an odd size taper and screw might be sacrificed to greater convenience for the user.

As far back as 1273, the use of coal in London was prohibited as a menace to public health. It had to be used a little later, however, as the forests were being destroyed. And *London Engineering,* in a recent comment on the smoke evil, naïvely adds: "It will probably remain with us for some time to come."

Readers with Something to Say

A letter good enough to print will be paid for. Ideas, not mere words, wanted

Renewing Boiler Stays

While it is customary in removing defective boiler stays to tap out the hole from which the old stay was removed to a larger size to receive a larger stay, such practice, in my opinion, is injurious to the boiler plate.

In boilers of the Scotch marine type I have frequently noted that the backs of the combustion chambers were pulled out of shape, and in every instance it was found that new and larger stays had been put in to replace defective ones at the point where the plates were distorted. Assuming that the greatest expansion takes place at the furnace plate, the tendency will be to push out the shell, and as the furnace plate is thinner than the shell it will give first; and where the new and larger stays have been installed a perceptible distortion will appear. To avoid such trouble I suggest turning down the new stay to the diameter of the original one, leaving its ends larger, as shown by the accompanying illustration.

IMPROVED BOILER STAY

With the stays all of a uniform sectional area, the chances for rupture and distortion will be fewer, and the boilers could be subjected to more severe usage without any resultant trouble.

J. A. CAMPBELL.

Providence, R. I.

What Broke the Pistons?

Our engines are all new, having been installed less than a year ago. After they were in operation for about six months the piston in the high-pressure cylinder of the 18 and 40 by 48-in. cross-compound engine was wrecked. The accident left the bull-ring unharmed in the head-end of the cylinder. When the pieces of the piston were counted we found 103 pieces. Some of the pieces dropped into the head-end exhaust port, causing the valve to suddenly stop, thereby bending the valve stem.

The piston rod was bent in three places and a new one was required; also a new piston and exhaust valve. The cylinder head and walls were badly cut in several places. At the time of the accident the engine was running condensing, direct-connected to a 600-kw. generator, at a speed of 100 r.p.m. It seemingly ran normally until a very few seconds before the occurrence.

About two months later the 24 and 54 by 48-in. cross-compound condensing Corliss engine was partly wrecked in the same manner as the former engine, the only difference being that part of the crosshead and crank were damaged. This engine runs a rope drive at 86 r.p.m., using steam at 175 lb.

Three weeks later this engine was again similarly damaged. The engines were not overloaded.

The volume of the piping connected to the steam header is greater than the volume of the header. There is a trap on the header and one on each steam receiver.

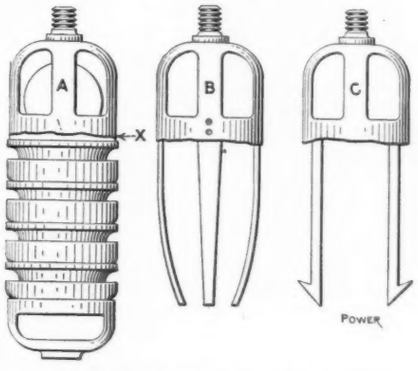
Some engineers seem to think that water accumulated in the piston until it became full and then the expansion broke it, filling the cylinder with water and the broken parts. What do POWER readers think was the cause?

A. I. HAIGHT.

Kalmazoo, Mich.

Lifting a Broken Plunger

Some time ago at the plant where I was employed the plunger on a deep-well pump broke as shown at *X* in the illustration, leaving the lower half of the plunger with part of the seat and the ball at the bottom of the pump barrel over 100 ft. down. At *B* is shown how I used the top of the broken plunger with four strips of steel made fast to it. The strips were bent so that the ends were a trifle smaller than the ball but would spring open to pick it up.



BROKEN PLUNGER AND LIFTERS

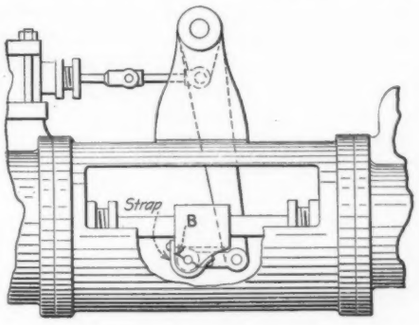
I then fastened two 18-in. pieces of steel, as shown at *C*, to the same top used to pick up the ball. These pieces were made so that when the points entered the hole in the seat they would spring together and hook onto the plunger. If other readers have a better way, I would like to hear of it.

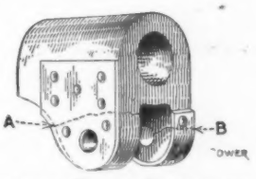
F. H. CORDNER.

Bradford, R. I.

Quick Pump Repair

While starting a duplex steam pump the crosshead broke as shown at *A* in the illustration. To get a new crosshead would have taken three or four days on account of our isolation. As the service would not admit of such a delay a ¼-in. iron plate shaped to cover the break was riveted on the crosshead together with the broken piece. The other side was broken as shown at *B*





BROKEN PUMP CROSSHEAD

and was repaired by a strap bent over the end and riveted.

The job was finished in an hour, and the pump has been in service for months without further trouble.

G. B. JOSHI.

Poona City, India.

Vacuum Caused Water-Hammer

While the effects of water-hammer are so generally known that little need be said of them, an investigation I made into the reason for an accident may be instructive.

The steam pipe to the engine had a long horizontal run to the engine where it dropped vertically to the throttle valve, which was provided with a drip to be opened when the throttle was closed. On

this occasion the attendant neglected to open the drip. Examination showed that over 22 ft. of the horizontal steam pipe was full of cold water, and that the remainder was hot as the water went back into the boiler as it formed. On opening the drip valve to drain the pipe, violent water-hammer occurred which burst the extra-heavy throttle valve.

As the pipe was 6 in. in diameter the body of water contained was great, and on opening the drip it was set in motion. As the water level in the pipe became lower, the top part of the cold pipe became exposed to the incoming hot steam which instantly condensed, forming a vacuum in the top of the pipe. The 100 lb. steam pressure then drove the water into the partial vacuum, producing great shock. As the drip valve was still open, the water returned to a level exposing more cold pipe and again producing a higher vacuum and a more severe shock. This operation was repeated each time the water returned to its level. The amount of water in the pipe became less as the travel and force of the water were greatly increased until eventually the blows, increasing in violence, burst the throttle valve. The effective force was greatest at this point, owing to the water under high velocity being suddenly stopped when it reached the valve. The reason water-hammer never happens to any extent in a vertical pipe is that the motion of the column of water is always downward and is closely followed by the steam.

Having been convinced of the correctness of the theory, the steam pipe to the engine was changed to slope toward the boiler from a point where it dropped vertically to the throttle. This allowed the water to return to the boiler and only the short vertical piece to become filled, and this could be quickly drained. If the water in the pipe had been hot a vacuum could not have been formed. The accident forcibly shows the advantage of a well drained steam pipe.

A. J. SAXE.

Chicago, Ill.

What Forms the Clinker?

In our plant there are three return-tubular boilers; No. 1 has a flat firebox and Nos. 2 and 3 have the Hawley down-draft fireboxes. The method of firing and the kind of coal are the same for all three boilers.

Much trouble has been experienced on account of clinkers forming on one side of the lower grate of No. 3 boiler, which is farthest from the stack. The rest of the grate of this and the other boilers burns very well. Can some interested reader tell me the cause of the trouble?

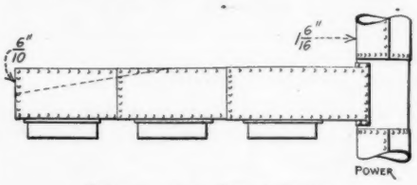
H. B. MCDOWELL.

Baltimore, Md.

Draft Troubles

In one plant the stack is very large and the breeching is of the one size throughout its entire length. In testing the draft at the main stack $1\frac{6}{10}$ in. was shown.

This condition is undoubtedly due to the breeching construction. If it was



STACK AND BREECHING

reduced as shown in the accompanying sketch, the draft for each boiler would be more uniform and the firing made much easier. The life of the boilers would also be materially lengthened.

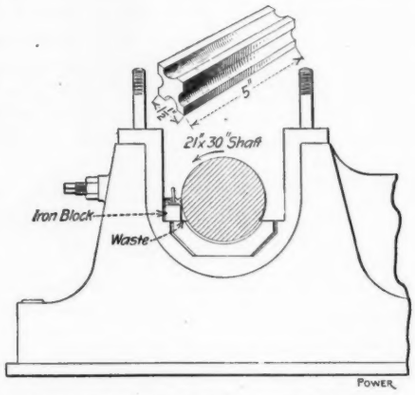
C. R. MCGAHEY.

Baltimore, Md.

Bearing Repair

In the plant in which I am employed there was a 40x60-in. engine driving a roll train, the bearing of which had become badly scored and was a continual source of anxiety and trouble.

It was out of the question to remove the shaft as there was a 70-ton flywheel to contend with, to say nothing of time lost on the mill, and it would have been folly to remetal the bearing and leave



ARRANGEMENT FOR CUTTING FACE OF SHAFT

the shaft in the condition it was. We decided to try to true it up, as there was little risk of making it worse than it was.

The cap was lifted and the quarter boxes removed; a tool used for turning sheet mill rolls, as shown in the accompanying figure, was placed in the position shown, hard grease and waste were put against the shaft below the tool to prevent chips from getting under the shaft, and a wedge was used to force the tool against the shaft. The engine was turned as slowly as possible and when enough metal had been removed, the tool was moved along to another position, and so on until the whole surface had been gone over; then fine emery cloth was used to finish it up. The shaft was then lifted enough to remove the bottom shell, the old metal was melted out and the shell replaced and remetalled.

Through an opening in the cap, three or four bars of hand Sapolio were placed on the shaft and the engine started. It was very warm for two or three hours, but by using oil freely and a little water occasionally to wash the bearing out, it was soon cooled.

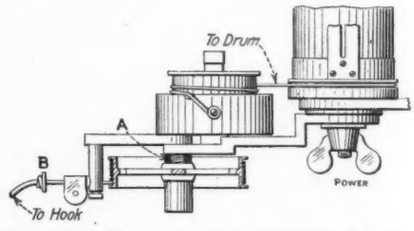
This bearing never gave any trouble afterward and was in fine condition when removed two years later to be replaced by a larger unit.

S. A. FRASER.

Middletown, Ohio.

Reducing Motion Kink

The figure shows a much used reducing motion, and the cords running to the indicator drum and to the crosshead or other moving part are marked. The cord wheel moves up and down on the threaded stem as the cord is drawn out



REDUCING MOTION WITH RUBBER INSERT

and allowed to return by the crosshead.

Ordinarily a piece of rubber or some such article is tied to the string at *B* so that, should the cord break or the hook slip, the wheel will not seat itself at *A*. A good many times the cord will snap, however, and the wheel seat itself so hard as to make the operation of loosening it highly injurious to the instrument.

The remedy is to place a small gasket —an elastic band will do—around the screw stem at *A*. No matter how hard the drum seats, the rubber will absorb so much of the energy that the drum may be readily released.

JOHN BAILEY.

Milwaukee, Wis.

Emergency Piston Repair

While employed in a sugar refinery as a night engineer, I was called on to repair a broken-off piston rod which was flush with the piston on one of our liquor pumps; the expansion packing rings and springs were also broken.

This pump had to be repaired at once and as we have no machinist at night and as it would have taken too long to

make a new rod, I filled the space between the ribs of the spider of the piston with wood blocks the thickness of the packing space and the diameter of the ribs of the spider. Then I put on two or three turns of old rubber belting the thickness of the blocks so I would have room to insert my packing. I also had the end of the piston rod tapped out for a ¾-in. cap screw. At the time of the repair we did not have any expansion rings or springs in stock, which was my reason for filling the space in the piston with wood and belting.

ROY STAHL.

Rising Sun, Ohio.

Eccentric Slipped

The engine which supplies power for a large factory was running normally when suddenly the speed decreased until the machines had to be stopped. The engineer quickly ordered the fireman to cover his fires with fresh coal and check

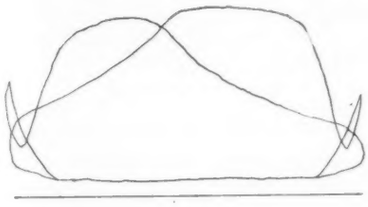


Fig. 1

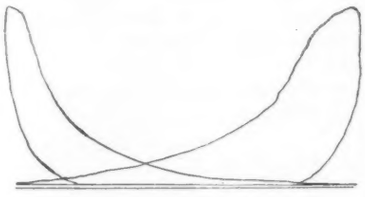


Fig. 2
Friction Load

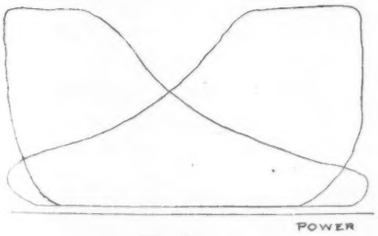


Fig. 3
Normal Load

the draft; then he shut the throttle valve, attached an indicator and secured the diagrams shown in Fig. 1.

After shutting down again, he loosened the setscrews which hold the steam eccentric in place, rolled it 8 in. in the direction that the engine ran and securely fastened it. The diagrams resulting from this adjustment are shown in Fig. 2. They show a friction load only, but when it was increased to normal and more diagrams were taken the result appears in Fig. 3.

The eccentrics on an engine should always be marked and a corresponding mark put on the crankshaft, so that if one or more are not properly lubricated, and consequently slip on the shaft, they can be quickly replaced. Failure to take this simple precaution has caused many engineers trouble and annoyance.

Every engineer in charge of anything larger or more complicated than a 15-hp. slide-valve throttling engine ought to have an indicator at hand at all times, know how to use it; and understand what a diagram tells after it is secured.

There are three interesting points about Fig. 1: It was taken from a double-eccentric engine; the exhaust eccentric is in a position to give good results; the steam eccentric is very late in performing its duty. These may easily be determined from the diagrams alone; no knowledge of the engine itself is necessary.

W. H. WAKEMAN.

New Haven, Conn.

Gear Cases

The factory was located a short distance from the freight yards of the railroad company and a spur was laid into the yards so that the heavy machines could be loaded and shipped.

To get a car into the shops so that they could be loaded with a crane necessitated the use of a large gear-driven drum over which passed a rope which was used as a capstan. The size of the large gear was about 4 ft. in diameter with a 4-in. face, going moderately slow and not covered by a shield.

As only the engineer was to operate this machine, it was assumed that no one would get hurt. He was told that many gears in the plant were uncovered, but he said they were safe and no one with average care could get caught in them.

Six months after, the engineer got his hand into these very gears, badly mutilating it.

The accident was due to the fact that the yard boss sent a helper to tell the engineer to start the machine. The man could not understand English so his boss had to talk to him in gestures. The man understood that he was to go and start the machine and pull the car into the building; he did start it up. Unfortunately the engineer was standing with his back to the direction from which the helper approached, leaning on the framework of the machine. When the helper started the machine, the engineer slipped and got his hand into the gears. Of course, after this accident all conspicuously exposed gears were carefully covered.

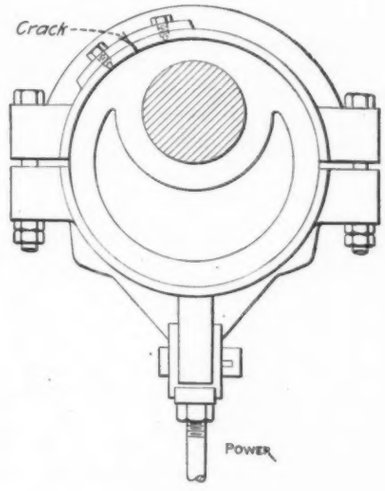
This is an actual occurrence and clearly shows the great negligence on the part of men in charge of factories, as well as machine designers. There are laws prohibiting the use of uncovered gears, projecting keys on shafts and projecting setscrews on pulleys, etc., but they are inadequately enforced.

R. FABRICE.

Brooklyn, N. Y.

Eccentric Repair

The accompanying illustration shows an emergency repair job on an eccentric strap. A piece of ¾x2-in. flat iron, 9 in. long, was shaped over the eccentric strap. The broken strap and the iron were then drilled for ¾-in. tap bolts. Care was taken to have the bolts pull against one another as shown.



BROKEN ECCENTRIC STRAP

The piece of iron was then heated red hot and bolted to the strap, and water was thrown over it. The aim was to take advantage of the contraction of the 9-in. piece to pull the broken straps together.

This repair served its purpose for several weeks before a new strap arrived.

A. POHLMAN.

Brooklyn, N. Y.

Bends for Blowoff Pipe

Much has been said about the value of bends on steam and high-pressure water lines. The blowoff line seems to have been forgotten.

Where the feed water leads to the formation of scale, the blowoff line often becomes plugged with the loose matter, causing much trouble. By installing bends in the line instead of ells, particularly near the boiler, much labor and time may be saved.

CHARLES G. FENWICK.

Wapella, Sask., Canada.

Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

A Narrow View

In answer to Frank Martin's question in the Apr. 16 issue, in my humble opinion, no engineer in an ordinary situation paying him anywhere from $12 to $18 per week has any right to purchase apparatus such as indicators, calorimeters, etc., for the use of the firm which employs him. If he is chief in a large plant and drawing several thousand dollars per year, the case is different and he should have them.

If the engineer in the first case mentioned is unmarried or can spare the money, and wants to learn how to use such instruments; then, too, the case is different.

An engineer who understands how to use these instruments and is employed by a wealthy concern which is too penurious to buy them, is an easy mark if he puts out his hard-earned dollars for machines for his employer's use. It is all right to say that an engineer should get these things for the sake of his own reputation, so that he can obtain and preserve a set of records showing exactly what the plant is doing, etc., but I venture to assert that the men who write such letters are the last ones themselves to do anything of the kind.

Talk is cheap, and ninety-nine out of a hundred engineers will refuse to spend a couple of hundred dollars for a set of instruments to increase a thankless employer's dividends, and in ninety-eight of the ninety-nine cases the engineer is right. Possibly in one case in a hundred the employer would make things right with his engineer after he saw the great advantage of having them in the plant, but the remaining ones would take it as a matter of course, and neither thank nor compensate the engineer for his outlay.

JOHN STRONG.

London Junction, Ont.

Power Plant Operating Costs

I was very much interested in the editorial under the heading, "Power Plant Operating Costs," in the Apr. 16 issue. Perhaps an experience I once had will be of interest. I was engaged as assistant engineer in a paper mill; it had a battery of five boilers, of a total of 700 hp. but, as was said in the editorial, there was no one taking any interest in the power end of the plant.

The chief engineer was called on to do every odd job, even to repairing holes in the roof. He told me that he did not get any time to look after the plant, and wanted me to see if I could make any improvement. The first day I was there the fireman came into the engine room about 10 o'clock and said I would have to shut down a couple of machines, as he was about to begin cleaning fires. To my surprise, I found that this had been the practice for quite a long time.

The water for the boilers was pumped from the river by a three-plunger pump through a home-made heater made of 4-in. pipe lengths inside of 6-in. pipe; the 4-in. pipe was connected with the pump line and the 6-in. line carried exhaust steam. The exhaust steam was first run through the driers of the paper machines and by the time it reached the heater it was nearly all condensed. From the heater it went into the sewer; the surplus water was taken care of by a relief valve which was connected to the second set of pipes. Thus all of the water had to go through one side of the heater before it reached the relief valve; about 90 deg. F. was the highest temperature we could get.

I put a relief valve in the line near the pump, which raised the feed-water temperature to 132 deg. The engines were piped for an indicator, but the firm did not have such an instrument. I persuaded a friend to lend me his, and if I had been a subscriber to POWER at that time I could have shown some diagrams that would have surprised its readers. On taking the head off the engine that showed the poorest diagram, we found one piston ring broken into a dozen pieces; it had been broken so long that the pieces were rounded on the edges. When new rings were put in and the valves properly set on all the engines, there was no trouble in keeping steam even while cleaning the fires.

The manager was interested right away, and told the chief to go ahead and put the steam end in shape. He installed a vacuum system of heating the driers, also a modern feed-water heater, with oil separators in the exhaust line so that the water of condensation was used for boiler feed, which then entered the boilers at 210 deg., and reduced the back pressure on the engines from 8 to 3 lb. As one boiler needed retubing, it was then cut out, and on taking out the old tubes we found 940 lb. of scale in it. That was the worst boiler in the plant, but all were badly scaled.

A rotary tube cleaner was purchased and also shaking grates. The plant now uses but four of the five boilers, it has plenty of steam, and burns from 28 to 32 tons of coal, where it formerly burned from 48 to 60 tons. Before the change it was almost impossible to keep the firemen, but the present crew has been with them over two years.

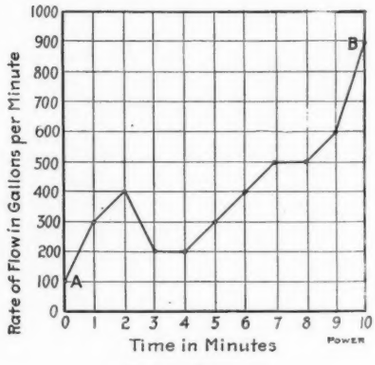
It seems queer to me that owners who are considered shrewd business men will allow such losses, but there are a great many plants in which conditions are equally as bad.

U. C. WOOD.

Copenhagen, N. Y.

The Arithmetical Mean

Prof. Smallwood illustrates one of his points in his article under the above title in the Mar. 12 issue by the consideration of a series of determinations made for the quantity of water discharged through a pipe line containing a venturi meter tube connected to a manometer. This illustration requires the use of a manometer scale graduated in inches difference of water or mercury levels.



FLOW CURVE

In laboratory work, a scale so graduated would be proper since students should be required to make their own calculations from the theoretical formula expressing the relation between differential pressures and rates of flow; in practice, however, the scale of a measuring instrument is usually graduated directly in quantity or rate. For instance, assume that a 10-minute test with a venturi meter having the scale graduated in "gallons per minute" gave the results shown by the accompanying curve.

the first reading of 100 gal. per minute being taken at *A* and the last reading of 900 gal. per minute at *B*. Between *A* and *B* 10 intervals of time of one minute each have elapsed. If we average the readings by the usual method for such a test, we obtain the following:

Time	Rate
0	100
1	300
2	400
3	200
4	200
5	300
6	400
7	500
8	500
9	600
10	900
	11)4,400
	400 = average rate

To correctly average, however, we should take the average of each interval, add the results together, and then take the average of the total as follows:

Interval	Average rate
0- 1	200
1- 2	350
2- 3	300
3- 4	200
4- 5	250
5- 6	350
6- 7	450
7- 8	500
8- 9	550
9-10	750
	10)3,900
	390 = average rate

The first method then shows an error of + 2.6 per cent., which might be of material importance in the test involved. This is a point which Mr. Smallwood does not bring out in his article.

Instead of averaging each interval as above, the following rule may be used for obtaining the correct average:

To one-half the sum of the first and last readings, add the sum of the intermediate readings and divide by the number of intervals.

Thus in the above test the correct average is:

$$\frac{\frac{900 + 100}{2} + 3400}{10} = 390$$

CHARLES G. RICHARDSON.

Providence, R. I.

Troublesome Feed Pump

In regard to A. J. Berlin's trouble with his feed pump, as related in the Apr. 2 issue, I think the cause of the disk shifting was that when he shut the pump down the valve disk would settle back, either by the pressure being off the feed line or the pressure caused by a leaky check valve; when he would start the pump, the vibration and direction of flow of the water would jar it onto its seat; this would be possible.

Something similar happened to one of our boilers some time ago, only the disk of the feed-water regulator unscrewed from of the stem. The first trouble was reported by the water tender of my shift; he claimed that the check was stuck, but by listening to what little water was passing through the regulator I came to the conclusion that this was the location of the trouble. After closing the feed valves, I took off the bonnet of the feed-water regulator and also took out the disk on account of the threads being worn, and fed that boiler by hand until we cut it out for cleaning, when we repaired the regulator.

I think the closing of the valve by the disk blew out the gasket between decks of his pump unless he had a number of boilers on the line as we did; then it ought not to have blown the gasket. Our pumps are provided with governors.

ROY STAHL.

Rising Sun, Ohio.

Temperatures in Engine and Boiler Rooms

Mr. Westerfield's letter under the above title in the Mar. 5 issue is interesting; but economy does not always result from keeping the windows closed, as the following cases will show.

In a flour-mill plant one of the generators would get so hot that we were often compelled to shut down and switch over on the city service. It was suggested that the window directly opposite the machine be left open. After doing this and letting the cold air blow on it, we had no further trouble.

In a central-station plant we were troubled with an overloaded alternator. This machine would run very hot and spark greatly, and also require an abnormal amount of exciter voltage to keep up that of the machine. Cold outside air was allowed to blow in through a window and the trouble disappeared.

All the piping was well covered, so I believe the losses incurred by more rapid radiation were more than compensated for by the increased efficiency of the generators.

M. A. JENSEN.

Nebraska City, Neb.

Centrifugal Pump Troubles

Milton Baker, in the issue of Mar. 26, presents a question of centrifugal-pump installation. The conditions as stated are that 2500 gal. of water containing some 8 per cent. of solids are pumped per minute through a 10-in pipe line 2000 ft. long and lifted to a height of about 70 ft. The troubles are caused by the occasional separation of the moving column of liquid, particularly when starting up or shutting down. The three pumps used are so spaced along the pipe line as to divide the total head about equally between them.

While the size used would be adequate for a short pipe line, it seems obvious that a larger size, say, 12 in., would have been far more advantageous. The velocity through a 10-in. pipe discharging 2500 gal. per minute would be about 10.2 ft. per second, corresponding to a velocity head of about 2 ft. The same quantity would pass through a 12-in. pipe with a velocity of 7 ft. per second, the velocity head being less than 1 ft.

In the issue of Apr. 4, 1911, page 523, it may be seen that the diagram showing the frictional head in feet per 1000 ft. of pipe, for the usual pipe sizes and for various quantities of water, gives, for 2500 gal. per minute, passing through a 10-in. pipe, a frictional head of 42 ft., which in this case, for 2000 ft. of pipe line, gives 84 ft.

The total head against which the pumps must work, neglecting the 8 per cent. solids which the water contains, is then 70 + 84 + 2 ft. velocity head = 156 ft.

The water horsepower is

$$\frac{2500 \times 156}{3960} = 98.5$$

The constant 3960 is used for clear water.

Assuming an efficiency of 55 per cent. for the type of pump used, the required brake horsepower is

$$\frac{98.5}{0.55} = 179$$

For a 12-in. line the diagram gives a frictional head of 16½ ft. per 1000 ft., or a total of 33 ft.

The total head would then be 70 + 33 + 1 ft. velocity head = 104 ft. The water horsepower equals

$$\frac{2500 \times 104}{3600} = 65.65$$

Assuming 55 per cent. efficiency, the brake horsepower is

$$\frac{65.65}{0.55} = 119.4$$

The difference in brake horsepower is 179 — 119.4 = 59.6, say, 60.

With a 12-in. line, only two pumps are required, since

$$\frac{156}{3} = 52 \text{ ft.}$$

head for each pump, and 52 × 2 = 104 ft., which is precisely the head calculated as required for the 12-in. pipe. The great economy to be gained by using a 12-in. line is now evident.

To remedy the present trouble with the least expense I suggest putting the three 10-in. pumps now used, at the No. 1 station, and connecting them in series; that is, the first pump discharging directly into the suction of the second, the second discharging directly into the third, and this latter discharging into the line. In this way it would not be necessary to install air chambers, check valves, reservoirs or sump holes, and the priming, starting and stopping would all be done at one single station and would be under perfect control.

If the work is to extend for a long period, say over a year, it might be well to investigate into the question of replacing the present 10-in. line by a larger size one.

ALBERT E. GUY.

Pittsburg, Penn.

Inquiries of General Interest

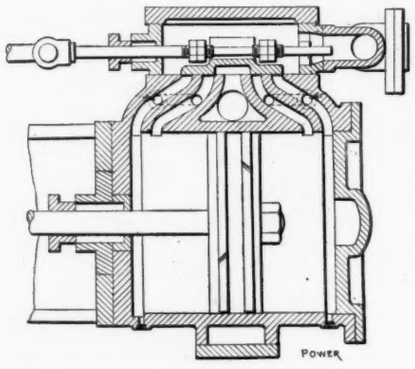
Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Cushion Valves

What are the valves located at each end of the cylinder on the outside of the steam cylinders of a duplex pump?

G. A. W.

They are cushion valves, and are located in a passage connecting the steam port with the exhaust port at each end of the cylinder. Referring to the illustration, when the piston covers the exhaust port near the end of the stroke, the piston is brought to rest, without any shock by compressing the small amount of steam left in the cylinder after the exhaust port is closed. The compression can be regulated by adjusting the compression or cushion valves, so as to permit the escape of more or less of the compressed steam into the exhaust port.



SECTION THROUGH CYLINDER

Height of a Horizontal Tubular Boiler over the Grate

What should be the distance from the grate to the bottom of the shell, the top of the bridge-wall from the bottom of the shell, and the back end from the rear wall, of a horizontal tubular boiler?

R. F. J.

The distance from the top of the grate to the bottom of the boiler should be about 24 in. for grates 4 ft. long, this distance increasing in proportion to the length of the grate. This applies to grates using anthracite coal only; for bituminous coal the distance should be increased from 30 to 36 in.

The distance from the back end to the rear walls should be about 16 in. for boilers less than 58 in. in diameter, and from 18 to 24 in. for larger boilers.

Usually 9 in. is the distance from the bridge-wall to the bottom of the boiler, for boilers up to 60 in., and 10 in. for larger sizes.

Westinghouse-Parsons Steam-Turbine Governor

How is the speed of a Westinghouse-Parsons turbine controlled?

J. M. M.

Steam enters the turbine through a poppet valve, controlled by the governor. At light loads the valve opens for short periods, remaining closed for the greater part of the time. As the load increases the valve remains open longer, until when full pressure is continually maintained in the high-pressure end of the turbine the valve merely vibrates without sensibly affecting the pressure of the steam. If the load is still further increased, an auxiliary valve begins to open and admits steam directly into the lower stages of the turbine.

Boiler Scale Solvent

Have molasses and tanbark any value as boiler-scale solvents?

J. K.

They will act by virtue of the acetic and tannic acid they contain. They may act on the scale, but they corrode the metal of the boiler.

Water Pail Forge

How is a "water-pail" forge made?

B. C. C.

The method of heating with a water-pail forge consists of plunging the metal to be heated beneath the surface of a conducting liquid; the metal should be connected to the negative pole of a continuous source of electric current. The vessel containing the liquid is provided with a lead lining, which is connected to the positive pole. To render the liquid conducting, a salt, such as sal soda, is dissolved in water to a specific gravity of 1.2, and to every 10 gal. of solution 5 lb. of borax are added.

Weight of the Governor Balls

Will changing the weight of the balls of a fly-ball governor affect the action of the governor?

G. McB.

Theoretically, the action of the governor is independent of the weight of the balls; practically, there is considerable friction in the mechanism of the governor, and the balls must have weight enough to overcome it.

Duty of Pumping Engines

What is the definition of "duty," as applied to pumping engines?

P. K. M.

Duty may be expressed as the number of foot-pounds of work obtained in the pump cylinders per 1,000,000 B.t.u. furnished to the engine by the boiler. Another definition is the number of foot-pounds of work done in the pump cylinder per 100 lb. of coal burned in the boiler; this, however, includes the boiler efficiency and the heat value of the coal.

Fan Capacity

How many cubic feet of air per minute must a fan furnish to a battery of boilers having a total capacity of 450 hp., assuming that 1 lb. of coal evaporates 8 lb. of water, and that 1 lb. of coal requires 230 cu.ft. of air for its combustion?

B. O. T.

Assuming that the boiler evaporates 30 lb. of water per horsepower per hour, the water evaporated per hour by the boilers would be

$$450 \times 30 = 13{,}500 \text{ } lb.$$

Since 8 lb. of water are evaporated per pound of coal

$$\frac{13{,}500}{8} = 1687.5 \text{ } lb. \text{ } per \text{ } hr.$$

or

$$\frac{1687.5}{60} = 28.12 \text{ } lb. \text{ } per \text{ } min.$$

The air required by the fan would be

$$28.12 \times 230 = 6467.6 \text{ } cu.ft. \text{ } per \text{ } min.$$

Loss of Current through Grounds

Does an electric circuit lose any current when one side of the system is grounded?

W. H.

No, if only one side of the system is grounded.

"Duff" Coal

What is "duff" coal?

S. A. G.

"Duff," according to the *Standard Dictionary*, means "small or fine coal," and is used to define washed bituminous slack.

The Power Show at Boston

A great success was the general verdict, not only in the number and quality of exhibits but also in the attendance. Engineers, mechanics and men prominent in the field from all over New England were there and were as enthusiastic about the show as the exhibitors were over the results of their attendance. The New England Association of Engineers, which made all arrangements and conducted its first power show during the week of Apr. 22-27 in conjunction with the third annual exhibition of textile machinery, is to be congratulated on its enterprise, and it is small wonder that it was unanimously decided to make the show an annual event.

The exhibition covered two large floors and the gallery of the Mechanics Building. The entire basement was devoted to power-plant exhibits and on the floor above were to be seen all kinds and types of textile machinery in operation, humidifiers and air-conditioning plants. In the gallery were samples of finished products and even made-up garments were exhibited here by some of Boston's leading retail merchants.

On Monday afternoon, at 2 p.m., the show was opened to the public, and during the evening between 6:15 and 7:30 the Commercial Engineers held a dinner which was attended by about 125 members and guests. The power show set aside Tuesday as engineers' Blue Room Club day and a large number of the members was in attendance. Wednesday was N. A. S. E. day for New England engineers. The National Association of Cotton Manufacturers also opened its annual convention in Paul Revere Hall, which was continued on Thursday.

A number of interesting papers were presented, and the following, which may be of interest to POWER readers, will be presented in later issues: "The Interpretation of Water Rights in Connection with Water Power," by Richard A. Hale; "Steam Plant Efficiency in Textile Mills," by R. L. Foster, and "Transmission of Power by Ropes," by Edwin Kenyon.

On Friday the Master Mechanics Association of America held its first convention. Three papers were read: one by John S. Schumaker on "The Attitude of Employer and Employee toward Scientific Management"; another by Edward A. Uehling on "Steam Boiler Efficiency," and the third was Mr. Foster's paper on "Steam Plant Efficiency in Textile Mills," which had been previously presented at the Cotton Manufacturers' convention. The two papers last named will be given early attention in these columns.

Saturday was the closing day of the show and was featured by a mid-day luncheon under the auspices of the Master Mechanics Association.

All of the exhibits were of interest, but a certain few, due to their arrangement or some distinctive feature, seemed to attract the visitors. Upon entering the hall the first booth to catch the eye was that of the Cork Insert Co., of Boston, in which were displayed a number of iron, wood, steel and paper pulleys with cork inserts. All were of large diameter and the background was made up of brake facings and "frictions" and "tensions" cut to suit all uses.

Hess-Bright Manufacturing Co. had an attractive exhibit the feature of which was a background case brilliantly illuminated and containing about 1500 bearings of different size and style of thrust, including annular bearings.

An optical illusion in the form of a series of chain drives operating behind a rotating, slotted disk was exhibited by the Link Belt Co. By looking through the disk, two of the chains were seemingly at a standstill, one appeared to move slightly in a forward direction and a fourth in a direction opposite to its travel. The object of the device was to illustrate the action of the chain on the sprockets.

The new spiro turbine of the Buffalo Forge Co., exhibited in connection with a complete air-conditioning apparatus for a two-story mill designed by the Carrier Air Conditioning Co. of New York, was a novelty.

Those interested in CO_2 recorders dwelt around the space occupied by B. L. Ames. Two Precision instruments were attached to the boilers of the building and were kept in constant operation. One of the machines had a 60-day chart on which were recorded both draft and the percentage of CO_2. In the same booth a Monarch steam soot-remover for water-tube boilers and superheaters was on exhibition and also a Climax smoke preventer with an improvement to eliminate all objectionable noise.

Not far away the Uehling Instrument Co. had one of its standard CO_2 and temperature-recording machines which was also attached to the boilers and in operation.

Austen & Doten, distributors for the National Tube Co., had a remarkable table made up entirely of samples of Shelby seamless steel tubing. It contained 3000 pieces and weighed 1700 lb. Kewanee specialties were, of course, in evidence, and an interesting feature was a testing machine showing how the unions are tested under water with compressed air.

John B. Perkins Co. showed a variety of products from the companies represented. These included Sarco traps and a CO_2 recorder, pump models, a new Perkins damper regulator, Alphons Custodis brick and particularly a special demonstrating model of a Hewes & Phillips Corliss engine with the new Franklin releasing valve gear. The cylinder, which was 10x24 in., was cut in two lengthwise and covered with a glass plate in order to show clearly the operation of the piston and valves under normal working conditions.

One of the features of the show was a 500-hp. Cochrane open heater, equipped with a V-notch and Lea recorder. A small circulating pump kept up a constant flow of water, and portholes in the wall permitted an inspection of the interior.

Immediately back of this exhibit, in the booth of the Robb Engineering Co., was a full-size return-tubular boiler front equipped with a 6x6-ft. Macdonald shaking grate. Test pieces of metal and a section of the joints, showing the style of riveting, were also in evidence.

At the booth of the Chapman Valve Manufacturing Co., the crowd never tired of watching the working of two gate valves, one electrically operated and the other hydraulically.

Another attraction was the immense No. 20 E Koerting Universal injector, exhibited by the Schütte & Koerting Co. It had capacity to supply 2500 boiler horsepower at 150 lb. working pressure. An electrically controlled engine stop succeeded in startling some of the lady visitors every time it was operated. Film specialties and other items made up the exhibit.

The Holyoke Machine Co. showed running exhibits of its new "Improved" hydraulic waterwheel governors of horizontal and vertical types, and also of its mechanical governor. The new governors created a great deal of interest, and were carefully compared with the Lombard governor, which, with its complete oil and air outfit, was exhibited in another booth in connection with a vertical wicket gate wheel, made by the S. Morgan Smith Co.

Perhaps the most conspicuous exhibit in the show was that of the Johns-Manville Co. With its various asbestos products neatly arranged under a portico covered with Transite shingles and the supporting columns twined with wistaria, the effect was most pleasing. A feature was the exhibit of "J. & M." sectional conduit and sponge filling for underground steam mains. Linolights brilliantly illuminated the booth.

To illustrate the difference in friction between the ordinary babbitted bearing and Sells roller bearings, the Grant Nail & Supply Co. exhibited a number of American iron pulleys and Gilbert wooden

pulleys, equipped with both types of bearing. A feature attracting considerable interest was a jackshaft, equipped with three pulleys running on roller bearings and driven by a small string.

The balance of the exhibits, many of which were just as attractive and interesting as those previously described, may well be classed under general headings covering the principal product exhibited.

Valves

There was a great display of valves of all types and sizes. The Ashton Valve Co. had a very attractive collection of its standard types, and a display of gages and sanitary drinking fountain, through which was dispensed "Adam's ale" to all comers.

The American Steam Gauge & Valve Manufacturing Co. was featuring the American H_2O grease-extracting feedwater filter and a new line of globe valves. A pyramid of brass safety valves, relief valves and whistles made a neat display.

The Lunkenheimer booth was attractive with its display of high-pressure steam valves, lubricators, grease cups and a special nonreturn stop valve.

Jenkins Bros., besides their usual line of valves and mechanical rubber goods, had a special exhibit of gate valves with iron and brass bodies.

Bashlin valves and faucets were exhibited by the Hyland Manufacturing Co.

Braman, Dow & Co., representing the William Powell Co., had a full line of "White Star" valves, globe, gate, blowoff and check, and an exhibit of the "ready" throttle valve.

Modulation-system valves and appliances for vacuum heating and air washer display parts formed the exhibit of Warren Webster & Co.

Monarch gate valves for all kinds of service and the Rothchild rotary gate valve were displayed by Mr. Hosley, New England agent for the Monarch Valve & Manufacturing Co.

Some of the Exhibits at the Boston Power Show

Pumps

The booth of the International Steam Pump Co. contained a combination exhibit of Blake & Knowles, Clayton and Deane apparatus. The company first named was showing a case filled with working models of its various types of pumps and one of its new single pumps for 250 lb. pressure. The Clayton exhibit was a small compressor for garage work. Deane triplex pumps, a 6-in. power weld head and a section of a single boiler-feed pump completed the exhibit.

The Goulds Manufacturing Co. showed a number of power pumps, the features of the booth being a double-suction, 4-in. centrifugal pump, and a centrifugal small enough to be carried around in a coat pocket, with a capacity of 30 gal. per minute.

The American steam pump was exhibited in the booth of J. B. Perkins, previously mentioned.

Boiler Accessories

A number of grates were on exhibition. The Burke Engineering Co. had a 6x5-ft. Neemes grate, the Canton Grate Co. displayed a 4x4-ft. grate of its make and a model, half size, was the exhibit of the Perfection Grate Co. H. F. Morse exhibited a full-size Cyclone grate, mounted in a brick setting.

The McLeod & Henry Co. was exhibiting its boiler-door arches and jambs, firebox blocks, back-combustion chamber and a model of a horizontal tubular boiler, showing the arches and firebox lining.

A working model of an economizer, a "Positivflo" heater section and a planing-mill exhauster comprised the exhibit of the Green Fuel Economizer Co.

A Richardson coal scale, weighing rice for convenience, was an interesting machine to watch, and an attractive booth was that of the Pennsylvania Flexible Metallic Tubing Co. The exhibit consisted of hose of various sizes, spirally wound with copper, including a special hose designed for blowing boiler tubes.

Steam Specialties

The Nashua Machine Co. had a working exhibit of the new Bundy trap, which now has a round body and has been simplified by doing away with the trunnion joints and the curved tube within. The working exhibit consisted of a receiving tank, lifting and return traps, operated by compressed air.

High- and low-pressure traps, a display of seamless copper floats and improved safety water columns were put on exhibition by the Wright Manufacturing Co., and in the same booth sections of Austin steam and oil separators were to be seen.

A. W. Barnes had a varied exhibit, consisting of Sterling float traps, made by the Templeton Manufacturing Co., a Hart force sight-feed lubricator and the Sherwood specialties, also literature on the American Ball engine and Mackie heaters.

Exhibits of the Tillotson Humidifier Co. were a humidifier and yarn steamer in full operation, and a line of ideal traps, among which was a new low-pressure trap with a 2½-in. outlet for handling large amounts of condensation.

G. P. Anderson, New England representative, displayed a line of the latest Rochester automatic lubricators, made by Greene, Tweed & Co., the Kieley specialties and American metal hose.

Another line, exhibited by the Nightingale & Childs Co., was the Swartwout steam specialties. Asbestos of varied finish added to the appearance of the booth.

The Mason Regulator Co. showed its full line of pressure-reducing valves, balanced valves of piston and beveled seated types, a pump speed governor and a hydraulic damper regulator.

The Elliot products at the show were grease extractors and filters, the T. W. regulator, float traps, oil separators, water alarms and the Faber blowoff valve. The features were a twin strainer and a new back pressure or relief valve, 12 in. in diameter.

Boiler-tube Cleaners and Soot Blowers

A number of well known cleaners were represented at the show. The Diamond Power & Specialty Co. showed five different soot blowers, featuring, however, the horizontal tubular and Manning types. The Liberty Manufacturing Co. called attention to its tube cleaners by raucous blasts from one of the motors. The Patterson Lubricating Co. showed the Lagonda line of cleaners, multiple strainer and reseating machine, and its own P. L. C. packing, while the Dean cleaners, as well as an improved gas analyzer for CO_2, CO and O, were placed in evidence by the William B. Pierce Co.

The Charles A. Claflin Co. exhibited its automatic and continuous-blast blowers for removing soot from fire-tube boilers, and various patterns of "Sure-Hold" adjustable clamp steam hose fittings.

Packings

Sheet, fibrous and metallic packings were well represented by the various brands of the following firms: France Packing Co., represented by J. Henry Blanchard; A. W. Chesterton Co.; Greene, Tweed & Co.; Peerless Rubber Manufacturing Co., whose "Rainbow" packing and belting, as well as the product of the Eureka Fire Hose Manufacturing Co., were displayed in a large booth by the Enterprise Rubber Co., of Boston; the Garlock Packing Co. and the Boston Belting Co., which had a full line of mechanical rubber goods.

Power-transmission Appliances

In this line the Reeves Pulley Co. demonstrated its variable-speed transmission, and, in addition, a number of wood split pulleys and clutches.

William Sellers & Co., Inc., had a large exhibit of various types of belt drive, illustrating its different products of manufacture; pulleys, hangers, shafting, binder frames, bicycle drives, etc.

Cotton transmission rope with wire center and screw couplings to avoid splicing was tested in a machine for the purpose in the booth of the Sampson Cordage Works. Several types of rope drives were also kept in motion.

An 84-in. steel pulley, with a 38-in. face, which had been in service for four years, was the feature of the Oneida Steel Pulley Co.'s booth.

The American Tool & Machine Co. was displaying steel pulleys, centrifugal oil separators and shaft hangers.

Several sizes of Samson friction clutches were on exhibition in the booth of George L. Fairbanks & Son, and the Dodge Manufacturing Co. showed its Orton and Dodge clutches, in addition to its several distinctive types of split pulley.

A wigwam, made up of Indian tan lace leather and an exhibit of Victor-Balata and Phœnix belting were offered for inspection by the New York Leather Belting Co., and in another space the Cling-Surface Co. was operating a testing outfit, to show the difference in pulling capacity between a belt under high tension and one treated with Cling Surface.

Oils, Filters and Lubricators

Lubricating oils for all purposes were in great abundance. Some firms had barrels of it and others sample phials, and in most cases cans of grease were included in the exhibit. The following firms were represented at the show: Albany Lubricating Co., American Oil Co., the Texas Co., Keystone Lubricating Co., Borne Scrymer Co. and the Underhay Oil Co.

The Richardson Phenix Co. had on exhibition one of the No. 2 Richardson individual automatic oiling systems, a Phenix type oiling system, a model M force-feed lubricator and a line of oiling apparatus.

S. F. Bowser & Co. featured a very complete and compact oil-filtration and circulating system, oil-can fillers for mill use and a number of other specialties. The Economy Lubricating Co., of Boston, showed the Economy and Lunkenheimer grease cups.

Force-feed lubricators, single, double, triple and eighteen-feed, made an attractive exhibit for the Hills-McCanna Co., Inc. An interesting feature was one of the old pop-bottle lubricators dating back to 1873.

The International Acheson Graphite Co. drew attention to its graphite products with an illuminated model of a furnace in which graphite is made.

Instruments, Gages and Meters

Apparatus of this kind was not lacking at the show. The Schaeffer & Budenberg Manufacturing Co. had an extensive and varied display of indicating and recording gages, tachometers, calorimeters and steam-engine indicators. Columbia recorders and "reform" mercury thermometers made up in gage form were the features attracting special attention.

A Venturi hot-water and steam meter with a quantity indicator dial, a recording chart and counter was the attraction offered by the Builders Iron Foundry, of Providence. The meter had a capacity up to 1500 boiler horsepower.

An Emerson fuel calorimeter and thermoelectric pyrometer were exhibited by the Emerson Apparatus Co. in conjunction with a textile conditioning oven and a small model of the Kilgour boiler setting.

The Standard Engineering Co. had a varied exhibit which included an Avery coal scale, a Thwing pyrometer and recording meters from the Industrial Instrument Co.

The Hohman & Maurer division of the Taylor Instrument Co. showed a varied line of meters, thermometers and gages, including a hygrodeik for determining relative humidity.

Miscellaneous.

Due to their size and the inconvenience of exhibiting large units, prime movers were not numerous at the show. The Brown Engine Co. had a 11x30-in. cylinder of its latest model, also the crosshead and governor. The Terry Steam Turbine Co. was operating a 15-kw. turbine direct-connected to a Crocker-Wheeler generator, and the Allis-Chalmers Co. exhibited a turbine in section in a large booth outlined by a number of its standard motors.

The General Electric Co. featured its cloth pinions, an ozonator and a variety of Mazda lamps.

Unions, flanges and pipe-fitting specialties were featured by the Jefferson

Union Co. The Auto Force air pump or ventilator could be seen from all quarters of the hall.

Engine stops, mechanically and electrically operated, an electrical pilot valve, a damper regulator and a vacuum breaker wired up in connection with the electrical stop drew attention to the booth of the Locke Regulator Co.

The Penberthy Injector Co. exhibited its auto-positive injector, the "XL" 96 ejector in several sizes and a line of oil and grease cups for stationary and automobile use. In the same booth the McCord Manufacturing Co. was showing its McKim gaskets and force-feed lubricators.

The large copper rotor of a 48-in. fan for handling steam and acid fumes attracted visitors to the booth of the Massachusetts Fan Co., which was also exhibiting a Davidson fan for general ventilation, the rotor of a squirrel-cage fan, a heater coil with internal bleeder and a 30-in. planing-mill exhauster.

Perolin, the new German boiler compound, and "Skookum" packing made by the Bowers Rubber Works, of San Francisco, were featured by the Eagle Oil & Supply Co., and in the near vicinity P. H. Hogan, New England manager of the Dearborn Drug & Chemical Works, was kept busy spraying "boiler compound" on visiting ladies and distributing literature on the treatment of boiler water.

Boiler Inspectors Hold Annual Banquet

On the evening of Apr. 23, in the American House, Boston, the American Steam Boiler Inspectors held their third annual banquet and election of officers. The election took place first and resulted as follows: President, M. S. King; vice-president, W. O. Young; secretary, A. R. Chambers; treasurer, Adam Oldfield; executive committee, J. F. Molloy, H. Van Ormer, C. D. Noyes, T. G. Ranton and James MacDonald.

About 70 members and guests sat at table and during the coffee and cigar period were addressed by a number of speakers.

W. H. Hamilton, of the Lukens Steel & Iron Co., told how openhearth steel was made at Coatesville, and F. N. Speller, of the National Tube Co., spoke on spellerized boiler tubes. His talk first dwelt on the subject of corrosion, which, due to its complicated nature, had only been recently understood. Iron will not corrode in dry air nor in water free from air. It is slightly soluble in water, and after it dissolves, air acting on the solution precipitates what is commonly called rust. To lessen corrosion iron must be made less soluble in water. Mr. Speller spoke on the effects of carbon, manganese, phosphorus, sulphur, silicon, oxides and cinder. Black cinder in iron accelerates corrosion by setting up galvanic action.

Uniformity in metal is the keynote to the whole situation. It must be uniform chemically as well as physically. At the works of the National Tube Co. physical uniformity is obtained by the use of specially knobbed rolls. To produce the best metal it is necessary to have central control over the various stages of manufacture and a system of checking the quality of the product on its way through.

Joseph H. McNeil, chief inspector and chairman of the Massachusetts Board of Boiler Rules, made a plea for more legible stamping of steel. Boiler inspectors find it difficult to identify steel after it has been rolled and made up into boilers. After an accident it is of the greatest importance to know the kind of steel and its maker, and this information cannot be readily ascertained unless a legible stamp has been imprinted on the sheet.

James G. Shaw conveyed the best wishes of the New York association and F. S. Allen, of Hartford, spoke briefly on the advancement of the engineer and the duties of the present-day inspector.

Frank Hinkley, an inspector of the Massachusetts District Police, referred to the three distinct bills now before the legislature of Massachusetts and urged the adoption of a separate and distinct department on boiler inspection.

John Molloy, retiring president, spoke on the benefit derived from the association both educationally and socially. He referred to the conditions of inspection twenty to thirty years ago when there were no laws, no regulations and nothing to guide the inspector except the orders of the company employing them. The inspectors are now a unit, they have a uniform set of instructions and Mr. Molloy is proud of the Massachusetts rules.

Other speakers of the evening were H. Cave, W. D. Haggerty, G. H. Lloyd, Henry M. Feldmann, T. G. Ranton, C. J. Nyquist and the new president, M. S. King.

BOILER INSPECTORS AT ANNUAL BANQUET IN AMERICAN HOUSE, BOSTON

Bad Breakdown at Manchester (Ia.) Power Plant

Early on Sunday morning, Apr. 14, while the large Corliss engine in the Manchester Light, Heat & Power plant was furnishing the power for the electrical machinery, the mammoth drive rod became unjointed in some unaccountable manner, and before the night man was able to shut off the steam the large cylinder head was forced out, causing a mishap which, had it happened during the day time, would have undoubtedly resulted seriously.

The company has recently installed an additional engine and dynamo. The damage to the engine is considerable, and it will be some time before it can be repaired.

Explosion in Chicago Steel Plant

On Apr. 14, the daily press reports a gas explosion in the power house of the Illinois Steel Co.'s South Chicago plant. The building was wrecked and the lives of over 100 workmen were endangered. There was a property loss of over $100,000.

Boiler Explosion at Kelso, Washington

The boiler in a small sawmill near Kelso, Wash., blew up early on the morning of Apr. 23, writes a correspondent from the West, and three men were badly scalded. The property damage is estimated at $1000. No information as to the probable cause has yet been ascertained.

Three Killed at Fredericksburg, Va.

According to press reports, three men were killed and three severely injured by the explosion of a boiler in H. N. Newbil & Son's sawmill, near Fredericksburg, Va., on Apr. 19.

Fatal Locomotive Boiler Explosion near Winnemucca, Nevada

On Apr. 22, near Winnemucca, Nev., the engine on freight train No. 49 exploded, killing the engineer, fireman and head brakeman, as stated by the local press.

The engine was completely wrecked, five cars were derailed and the track torn up for a considerable distance. The cause is unknown. It is said that the engine had been thoroughly overhauled and repaired and inspected by the state officials.

Killed by Bursting Boiler

At Bloomington, Ind., on Apr. 26, engine No. 217, while in motion in the Monon yards, was badly wrecked by the explosion of its boiler. The engineeer was instantly killed, and the fireman, who probably owes his life to the fact that he had just filled the firebox and was sitting on the tender, was hurled across two tracks, over a caboose and landed on the next track. Although he was severely burned about the face and arms, no bones were broken, and he is likely to recover. The engineer was thrown through both sides of a box car nearby, a part of the cab going with him, and was picked up lifeless 50 ft. away.

The press reports are unable to say whether the accident was due to high pressure, low water or to faulty boiler construction.

Formerly used both in the Bloomington yards and on the road, the engine was rebuilt and used as a pusher up to the time it exploded. The state boiler inspector will make an investigation.

OBITUARY

Hinsdale Parsons

On Apr. 28, Hinsdale Parsons, vice-president and general counsel of the General Electric Co., was instantly killed by the overturning of his automobile, near Albany. Mr. Parsons was 45 years old, and had been associated with the General Electric Co. since 1894 as counsel, and in 1901 was elected vice-president.

He is survived by his wife and four brothers. James, another brother, who was U. S. consul at Mexico, was killed in a similar accident five years ago.

Jacob E. Friend

Jacob E. Friend, of Milwaukee, Wis., president of the Nordberg Manufacturing Co., and a prominent resident of that city, died suddenly from heart disease in the street in Florence, Italy, on Apr. 20, while *en route* to New York from a trip through the Orient. Mr. Friend was accompanied by Mrs. Friend and their daughter Margaret, who sailed from Florence to New York on Apr. 25, and have, it is said, brought the remains with them.

J. E. Friend

Mr. Friend was born in Milwaukee 54 years ago, the only child of Mr. and Mrs. Elias Friend. He was educated in the local schools, and later took a course in the Columbia Law School, New York City. Soon afterward he engaged in law practice in his home city, and formed a partnership which continued until a few years ago, when he retired to take an active part in the affairs of the Nordberg Manufacturing Co.

Soon after attaining his majority, Mr. Friend served a term in the Wisconsin Legislature. He was a prominent member of several social clubs, a director in a bank and several insurance companies, and figured in many large commercial enterprises.

PERSONAL

Warren B. Flanders, who has been connected with the steam-turbine department of the Westinghouse Machine Co., East Pittsburg, Penn., left on May 1 to accept a position with the Havana Electric Co., of Havana, Cuba.

Clark, MacMullen & Riley, Inc., consulting engineers for the design of heating, ventilating and electrical equipments, have removed their offices to the Eighty Maiden Lane Building.

CORRECTION: The curve in Fig. 2 of the article under the title "Calculation of Heat Value of Coal," in the issue of Apr. 16, pages 558 and 559, is copyrighted by the Under-Feed Stoker Co. of America. A statement of this fact was inadvertently omitted from the article.

Moments with the Ad. Editor

"Three illusions are common to nearly all men. Nearly every man thinks that he thoroughly understands human nature, that he can run the local newspaper better than the editor runs it, and that he can write advertising."

So delivers himself a prominent national advertiser—who is besides, we might add, a keen analyst of his fellow-kind, with some right notions on advertising in general.

"That he can write advertising!"

You all have heard and perhaps know some specimens of the fellow who thinks he could make Greeley, Dana, Pulitzer & Co. look like twenty-nine cents in the newspaper game (if he only wanted to)—and you know the other fellow, who believes he can read and interpret, without a miscue, all the motives, actions and secret thoughts of the folks next door.

But—the man who thinks he can write advertising if he only wanted to—he's a newer phenomenon. New, probably, because advertising in the right sense is itself more or less new.

Why is it so many people think they can write advertising, especially those who, able or expert in some other line, really haven't the least qualification or aptitude for the job?

Because advertising is thought of as authorship—as writing.

We're a nation of authors. Go past the newsstand for proof. Doctors, lawyers, merchants, thieves, professors and old ladies—write. If a financier or a second-story operator is laid up at home with the gout or laid out at home with a billy, he fills in the enforced leisure by writing a book—about something. Novel, poem, play, essay, book of travels, "true" story of somebody, "appreciation" or damnation, *something* about *something*. And everybody reads—reads—reads.

Thus, it is easy to account for such widespread belief—or conceit—in ability to write advertising, when advertising is looked on as "authorship."

But consider a moment—

These tons of cheap, hurriedly, ignorantly written novels, stories, plays, etc., that stack the newsstands—people are not really *influenced* by reading such. Such stuff is bought to fill in the time, exactly as a lot of it is written—because the writer didn't have anything else in particular to do.

Now, *advertising* that is *written* in this way, will be *read* in this way. It'll be a soporific (see Dictionary!), not stimulus to action.

But, let us whisper you this—

Real advertising is *only incidentally* writing. It is salesmanship that simply happens to be talking *per* the printed page—"happens to be," because it found a magnificently big opportunity to talk thus *through the eyes* of ten thousand humans at once instead of *through the ears* of the ten thousand in succession—if it could find 'em.

Of course, let us hasten to say, advertising has not shoved the real genus homo salesman out of his job, any more than the telephone has abolished letter writing; for, as the telephone simply does more swiftly and cheaply a myriad things the letter used to do, leaving the letter to confirm, to clinch the bargain, so with advertising and the salesman—who lands the prospect that the ad. fishes up, who closes the sale that the ad. begins, and who does some certain other things only a thinking man on two legs can do. One great advantage of advertising over the salesman system simon pure, outside of its superior economy, is that advertising *discovers possibilities of business* in places where the salesman never dreams of looking.

But we're talking just now about *writing* ads.—and the gist of it all, with which we end, is "these"—

AN AD., "as is one," can't be written by the fellow who hasn't in him the spark for firing others to action—feeling-action, thought-action—any more than the Odyssey could be written by the office boy. The real ad-man, ad-builder and ad-dreamer, instead of and far from being a mere pen-shover, is—75% of him at least—that vivid, imaginative, dynamic genius of this modern time—SALESMAN.

NEW EQUIPMENT

ATLANTIC COAST STATES

The Rutland Ry., Light & Power Co. is making arrangements for the construction of a substation at South Poultney, Vt. Three 100-kw. transformers will be installed. G. S. Haley, Rutland, Vt., is general manager.

Fall River, Mass., contemplates the expenditure of $20,000 for improving the water-works system.

The Amityville Water Co. is planning to construct a new pumping station in connection with the power plant of the Long Island Lighting Co., at Amityville, N. Y.

Bids will be received by the Village Board of Trustees, South Orange, N. J., for furnishing two water-tube boilers. John Fitzsimmons is village clerk.

The city council has granted a franchise to the Butler County Light Co. to construct and operate an electric-light plant, at Butler, Penn.

The Pennsylvania Power Co. contemplates extensive improvements to its local power plant at Ellwood City, Penn. M. V. Knapp, Elwood City, is general manager.

D. D. Ehrhardt is chairman of a committee appointed to investigate the feasibility of installing a water-works system at Hanover, Penn.

The Floyd Electric Light, Heat & Power Co. contemplates the construction of an electric-light plant at Brockwayville, Penn. E. M. Floyd is interested.

The Wilson-Irvin Construction Co., Hagerstown, Md., has been granted a franchise to construct and operate an electric-light plant at Mount Airy, Md. Estimated cost, $10,000.

Joseph Roach is considering the construction of an electric-light plant at Highfield, Md.

The Coeburn Light & Power Co., Coeburn, Va., is considering extensive improvements to its plant. T. B. Hillman is manager.

The Clinchfield Coal Co. contemplates the construction of three substations in connection with its mines at Dante, Va. Each station will contain two 300-kw. motor generator units; additional boiler capacity will be required at central station.

SOUTHERN STATES

Ira I. Weaver and Robert L. Finlayson are considering the installation of an electric-light system in Shinnston, W. Va.

The citizens of Kernersville, N. C., have voted bonds for $5000 for the construction of a municipal electric-light plant.

The citizens of Lavonia, Ga., have voted to issue bonds for $50,000 for the construction of an electric-light plant.

Lake Helen, Fla., will soon vote on the proposition to construct an ice, water and electric-light plant. A. D. Clarkson is interested.

The Geneva Power Co. has been incorporated to build an electric-light plant at Geneva, Ala. D. O. Vaughn is interested.

John Kennedy is a member of a committee appointed to investigate the question of constructing a municipal electric-light plant at Biloxi, Miss.

CENTRAL STATES

The board of trustees of public affairs, Bryan, Ohio, is receiving bids for one 450-kw. engine, 375- or 175-kw. alternating-current revolving field, engine-type generator, one 40-kw. motor-generator set with switchboard instruments, panels, one 50-hp. motor and three-stage air compressors.

The Interstate Electric Co. proposes to construct a power plant at Edinburg, Ind.

Adolph Leimgnibe, London, Ind., will soon receive bids for the construction of an ice plant and equipment. Plans are now being prepared.

The electric-light plant, at Lawrence, Mich., was recently destroyed by an explosion.

WEST OF THE MISSISSIPPI

The Oakland Electric Co. will soon start work on the construction of an electric-light plant at Oakland, Iowa.

Plans are being prepared for the construction of a water-works system at Paullina, Iowa. Estimated cost, $8000.

A franchise has been granted to the Troy Canning Co. to construct and operate an electric-light plant at Williamsburg, Iowa.

L. E. Milligan, president of the state school for deaf and blind, Boulder, Mont., is receiving bids for the construction of a power plant at the school. Link & Haire, Butte, Mont., are the architects.

Bonds for $27,000 have been voted for the installation of a water-works system, at Pleasant Hill, Mo.

Plans have been prepared by Winters & Dove, Merchants National Bank Bldg., Fort Smith, Ark., for the construction of a water-works system at Springdale, Ark.

The Ouachita Electric Co. has been incorporated to build an electric-light plant at Malvern, Ark. William Kilpatrick, president; W. R. Duffie, vice-president; Orson Kilpatrick, secretary-treasurer.

The Hot Springs Water Co., Hot Springs, Ark., is receiving bids for the installation of a 750-kw. steam turbine in its plant. Stanley Johnson is chief engineer.

Charles Schraff is interested in the construction of an electric-light plant at Alpine, Tex.

ENGINEERS WANTED

Under this head are published, without charge, advertisements of actual vacancies in power plants for operating engineers and assistant engineers. For the guidance of applicants for advertised positions, the advertisements must contain particulars to show the class of service demanded and the wages paid. Employers who desire to advertise under this head are requested to write for a blank form of application.

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

SALESMAN — Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," Power.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesman Address G. L. Simonds & Co., 802 Steinway Bldg., Chicago, Ill.

AGENTS WANTED to sell forced draft blowers and damper regulators; will give exclusive territory to right parties; commission on sales. Turbo-Blower Co., 30 Church St., New York.

AGENTS selling to steam plants can make big money selling for us; no samples; no experience is necessary. Armstrong Mfg. Co., Springfield, Ohio.

SALESMEN who have established trade among boiler users; good salary, expenses and liberal bonus. Reiter Boiler Cleaner Co., Elgin, Ill.

AN EXPERIENCED salesman of steam specialties for Central West territory; state age, experience, where obtained and salary expectations. The Ohio Brass Co., Mansfield, Ohio.

MANUFACTURERS' AGENTS to handle thoroughly guaranteed steam specialties; feed water heaters, steam and oil separators, traps and exhaust pipe heads; not necessary to represent entire line if interested in only part of it; our specialties are well advertised and of good reputation. Box 569, Power.

SITUATIONS WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

GRADUATE mechanical engineer, age 24, two years' experience, desires position; able to conduct boiler and engine tests; can handle men. Box 653, Power.

MECHANICAL and electrical engineer, technical graduate, 32, desires operating position; experience in designing and erecting machinery for engine building company, and as testing engineer for group of power plants. Box 652, Power.

MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

PATENTS SECURED—C. L. Parker, Patents, 904 G St., Washington, D. C.

SELLING AGENTS wanted in important centers for Betson plastic fire brick; see page 132 in this issue.

PATENTS—Herbert Jenner, patent attorney and mechanical expert, 608 F St., Washington, D. C. I make a free search and report if patent can be had and the exact cost.

WANTED—To buy electric light plant in a good city of about fifteen hundred to three thousand people, west of the Mississippi. Address W. M. Donner, Rossfork, Idaho.

ENGINEERS AND FIREMEN—Send 10 cents in stamps for a 40-page pamphlet containing a list of questions asked by an examining board of engineers. Stromberg Publishing Co., 2703 Cass Avenue, St. Louis, Mo.

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today, M. Y. C., 1417 W. Jackson Blvd., Chicago, Ill.

FOR SALE

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

20x48 CORLISS engine, excellent condition, $650. Duzets & Son, Hudson Terminal, New York.

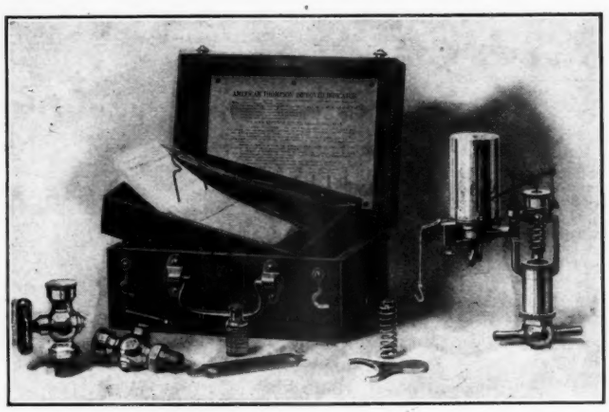
CHEAP—One 30-hp. Diesel oil engine with duplicate parts of a wrecked one. Seib Bros., 96-100 Boyd Ave., Jersey City, N. J.

350 KW. WESTINGHOUSE generator, 250 volts, direct connected to 24x36 heavy duty Corliss engine; unit complete with switchboard and balancing set. Arthur S. Partridge, 417 Pine St., St. Louis.

ONE 150 HP. BALL automatic 16x16-in. engine, direct connected to 100 kw., 115 volt, d.c. G. E. generator. $1550. One 28 hp. Harrisburg automatic 8½x8-in. engine, direct connected to 18 kw., 115 volt d.c. Westinghouse generator. $600. Three 72-in. by 18-ft., 150-hp. butt joint H. T. boilers for 125 lb. pressure, with H. D. D. furnaces and I-beam suspension. $600 each. All in fine condition, taken out to make room for larger units. The above prices are all f.o.b. Portsmouth, Ohio. The Selby Shoe Co.

(Continued on page 60.)

Big Economies Effected By The Use Of The American-Thompson Indicator



The American-Thompson is the original Thompson Indicator. It is the most imitated instrument on the market. To be absolutely sure of getting the right indicator, ask for the "American-Thompson Indicator made by The American Steam Gauge and Valve Mfg. Co." Always specify it in that way.

Bigger economies than perhaps you realize. And within the grasp of any Engineer who cares to reach for them.

There's a big economy in fuel, effected through the use of an American-Thompson Indicator. You can never stop the everlasting waste of fuel nor maintain the engine at its proper efficiency unless you know the condition of the valves—and this the American-Thompson Indicator will tell you.

And there's economy in steam. With an American-Thompson Indicator you can learn how to make every ounce of steam count. You can tell whether the piston is tight and whether the valves are leaking.

Economy and system go hand in hand—they are fundamental principles of all enterprises, large and small; and by these practices grow and prosper.

The American-Thompson Indicator has stood the test for more than 40 years, and has proven, without a doubt, a boon to thousands of Engineers. With careful use of this instrument a multitude of economies are given to the Engineer who wishes to save.

$5.00 Down $5.00 Monthly

The price of the outfit as shown is $55.00, with reducing wheel $65.00. The cost of the detent motion is $15.00. The terms are easy—made easy to put this standard instrument within your immediate reach—$5.00 down and $5.00 per month.

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Alphabetical Index to Advertisers

Page

Acme Furnace Equipment Co. 73
Albany Lubricating Co....101
Albany Steam Trap Co....100
Alberger Heater Co.....106
Allan & Son, A.....150
Allis-Chalmers Co.....148
American Engine Co.....148
American Engineering Co. 12, 13
American Injector Co.....127
American Mfg. Co.....106
American Metal Hose Co..140
American School of Correspondence 141
American Steam Gauge & Valve Mfg. Co.....58, 59
American Steam Packing Co. 118
Anderson Co., V. D.....104
Armstrong Mfg. Co., The.. 92
Ashcroft Mfg. Co..... 85
Ashton Valve Co..... 95
Austin Separator Co.....102

Babcock & Wilcox Co.....138
Ball Engine Co.....144
Bard Union Co..... 75
Barnes Co., W. F. & John..127
Bartlett & Snow Co., C. O..132
Bass Fdry. & Machine Co..137
Bates Machine Co.....113
Bessemer Gas Engine Co..143
Betson Plastic Fire Brick Co. 132
Bigelow Co.....136
Bignall & Keeler Mfg. Co. 98
Blaisdell-Canady Co..... 96
Blake & Knowles Steam Pump Works.....110
Borden Co..... 92
Bowser & Co., Inc., S. F... 97
Bristol Co., The.....108
Brown Hoisting Mchry. Co.123
Bruce-Macbeth Engine Co., The 142
Buckeye Engine Co.....142
Buffalo Forge Co.....159
Builders Iron Foundry.... 81
Burt Mfg. Co..... 14

Cahall Sales Co.....138
Cameron Steam Pump Works, A. S.....125
Canton Grate Co.....128
Casey-Hedges Co.....136
Chapman Valve Mfg. Co... 84
Chesterton Co., A. W.....118
Connersville Blower Co., The 124
Consolidated Safety Valve Co. 85
Consolidation Coal Co., The 8
Cooper Co., C. & G.....145
Cresson Co., Geo. V.....106
Crosby Steam Gage & Valve Co..... 81
Cruise & Co.....134
Curtis & Curtis Co..... 95
Cyclone Grate-Bar Co.....131

Dallett Co., Thos. H.....132
Dart Mfg. Co., E. M..... 93
Daum Co., A. F.....122
Deane Steam Pump Co.....123
Dearborn Drug & Chemical Works..... 5
De Laval Steam Turbine Co.158
De La Vergne Machine Co.140
Deming Co.....125
Detroit Lubricator Co..... 98
Diamond Rubber Co.....117
Direct Separator Co..... 77
Dixon Crucible Co., Jos....100
Durabla Mfg. Co..... 82

Page

Edge Moor Iron Co.....136
Elliott Co..... 7
Endura Mfg. Co.....118
Engineer Co.....111
Engineers Appliance Co., The 88
Erie City Iron Works.....151
Eureka Packing Co.....72, 79

Fidelity & Casualty Co....106
Fishkill Landing Mach. Co.140
Fitchburg Steam Engine Co. 144
Flexible Steel Lacing Co..109
Flinn, Richard J.....100
Flower Co., Walter L..... 96
Foster Engineering Co.... 88
Freeman & Sons Mfg. Co., S.....138

Garlock Packing Co..... 9
General Electric Co.....161
Goetze Gasket & Packing Co. 114
Golden-Anderson Valve Specialty Co..... 84
Goodnow Fdry. Co., L. H..108
Goulds Mfg. Co.....124
Graver Tank Works, Wm..135
Green Engineering Co.....127
Green Fuel Economizer Co. 75
Greene, Tweed & Co., 71, 4th cover
Griffith & Wedge Co.....144
Gutta Percha & Rubber Mfg. Co.....118

H. & M. Valve Co..... 82
Hamler-Eddy Smoke Recorder Co.....126
Hammel Oil Burner Co....127
Hancock Inspirator Co.... 85
Harris Steam Engine Co., Wm. A.....145
Harrisburg Foundry & Machine Works.....145
Harrisburg Mfg. & Boiler Co. 136
Harrison Safety Boiler Works 61
Hawk-Eye Compound Co..135
Hayden & Derby Mfg. Co.. 85
Heine Safety Boiler Co....139
Hercules Float Works....114
Hess-Bright Mfg. Co.....120
Hewes & Phillips Iron Works 146
Hoffman, Geo. W.....116
Homestead Valve Mfg. Co. 89
Hooven, Owens, Rentschler Co. 147
Hoppes Mfg. Co.....112
Hoskins Mfg. Co.....135
Houston, Stanwood & Gamble Co.....144
Howard Iron Works..... 84
Hunt Co., C. W.....109
Huyette Co., Inc., Paul B..134

Ingersoll-Rand Co.....156
International Corr. Schools. 65

Jenkins Bros..... 63
Johns-Manville Co., H. W.. 69

Keeler Co., E.....136
Kellogg Co., M. W..... 92
Kelly Foundry & Machine Co. 128
Kennicott Co., The.....132
Kerr Turbine Co..... 80
Keystone Lubricating Co.. 3
Kincaid Bros.....122
Kinkead Mfg. Co..... 78
Kunkle & Co., E. B..... 74

Page

Lagonda Mfg. Co....3d cover
Lammert & Mann.....149
Leavitt Machine Co..... 94
Locke Regulator Co....109, 144
Long Grate Bar Co.....128
Lord Co., Geo. W.....114
Lunkenheimer Co..... 4
Lytton Mfg. Corporation.. 75

McClave-Brooks Co.....129
McCord Mfg. Co.....115
McGowan Co., John H.....125
McGraw-Hill Book Co.....160
McIntosh, Seymour & Co..145
McLeod & Henry Co.....133
Magnolia Metal Co.....152
Manning, Maxwell & Moore 85
Manzel Bros. Co..... 97
Martin Grate Co.....128
Mason Regulator Co..... 83
Michigan Lubricator Co... 97
Milne Water Tube Boiler Co. 136
Monarch Valve & Mfg. Co. 86
Montgomery & Co.....126
Morehead Mfg. Co.....104
Morrin Climax Boiler Co..136
Morse Chain Co.....162
Morse, R. F.....132
Mound Tool & Scraper Co.116
Murphy Iron Works.....131
Murray Iron Works Co....144
Murray Specialty Mfg. Co..122

Nashua Machine Co..... 76
National Pipe Bending Co.112
National Tube Co.....90, 91
Neemes Bros.....130
Nelson Valve Co..... 87
Newhall Engr. Co., Geo. M.105
New Bedford Valve Mfg. Co. 82
New Process Raw Hide Co.155
New York Continental Jewell Filtration Co., The...134
New York Edison Co..... 80
Nicholson & Co., W. H....104
Nordberg Mfg. Co.....150
Nugent & Co., Wm. W..... 98

Ohio Blower Co..... 78
Ohio Brass Co..... 93
Ohio Injector Co..... 84
Oil City Boiler Works.....137
Open Coil Heater & Purifier Co. 110
Oster Mfg. Co., The..... 92

Page Belting Co.....109
Parker Boiler Co.....137
Parson Mfg. Co..... 77
Patterson & Co., F. L.....110
Peerless Rubber Mfg. Co., 10
Penberthy Injector Co.... 11
Pennsylvania Flexible Metallic Tubing Co.....132
Perfection Grate Co.....131
Pierce Co., Wm. B....2d cover
Pittsburgh Valve, Foundry & Construction Co..... 84
P.-K. Engineers.....122
Powell Co., Wm..... 82
Power & Mining Mchry. Co. 74
Power Specialty Co....116, 135
Pratt & Cady Co..... 73
Precision Instrument Co..137
Providence Engr. Works..146

Quimby, Inc., Wm. E.....123

Reliable Water Gauge Co..122
Reliance Gauge Column Co.134
Remington Oil Engine Co..147

Page

Rhoads & Sons, J. E.....124
Richardson-Phenix Co..... 67
Ridgway Dynamo & Engine Co. 147
Riverside Metal Refining Co. 145
Robb Engineering Co., Ltd. 96
Robertson & Sons, Jas. L.. 79
Rogers Co., H. A.....100
Rollins Engine Co.....153
Rooksby & Co., E. J.....149
Royersford Foundry & Machine Co.....108

"S-C" Regulator Co., The..126
Saginaw Mfg. Co.....106
St. John, G. C.....126
Salamander Grate Bar Co.127
Scaife & Sons Co., Wm. B.135
Schade Valve Mfg. Co..... 88
Schaeffer & Budenberg Mfg. Co. 78
Schieren Co., Chas. A., 1st cover
Schuchardt & Schütte..... 77
Schutte & Koerting Co....107
Sherwood Mfg. Co..... 98
Simmons Co., John..... 89
Simonds & Co., G. L..... 81
Skinner Engine Co.....146
Smooth-On Mfg. Co..... 6
Squires Co., C. E.....102
Standard Oil Co.....100
Starrett Co., L. S.....124
Steel Mill Packing Co.....118
Stephenson Mfg. Co.....157
Sterling Blower & Pipe Mfg. Co.....134
Sterling Machine Co..... 99
Stocker, Geo. J.....116
Struthers-Wells Co.....142
Sturtevant Co., B. F.....107
Superior Iron Works Co....127

Terry Steam Turbine Co...149
Thacher & Co., George H..121
Treadwell Co., Inc., M. H..128
Trill Indicator Co.....126
Trimont Mfg. Co.....141
Tripp Metallic Packing Co.116
Tudor Boiler Mfg. Co.....136
Turbo-Blower Co..... 74
Turner Fricke Mfg. Co....140

Uehling Instrument Co....132
Under-Feed Stoker Co. of America 76
Underwood & Co., H. B....154

Vanda Co., The.....119
Vilter Mfg. Co., The.....147
Vogt Machine Co., Inc., H.136

Walker & Co., Ltd., James.116
Washburn & Granger Co..128
Watson & McDaniel Co...125
Watts-Campbell Co.....146
Webster & Co., Warren...110
Westinghouse Machine Co.162
Wetherill & Co., Inc., Robt.144
Wheeler Condenser & Engineering Co. 121
Wheeler Mfg. Co., C. H....125
Whitlock Coil Pipe Co..... 94
Wickes Boiler Co., The....135
Williams & Co., J. H..... 75
Wing Mfg. Co., L. J. 114
Wisconsin Engine Co.....103
Worthington, Henry R....124
Wright Mfg. Co.....102
Wyckoff & Son Co., A..... 92

Yarnall-Waring Co..... 89
York Mfg. Co.....149

Classified Index to Articles Advertised

Air Chambers
Hercules Float Works....114

Air Compressors
Allis-Chalmers Co.....148
Bates Machine Co.....113
De La Vergne Machine Co.140
Ingersoll-Rand Co.....156
Nordberg Mfg. Co.....150
Vilter Mfg. Co.....147
York Mfg. Co.....149

Air Cooling Apparatus
De La Vergne Machine Co.140
York Mfg. Co.....149

Alarms, Low Water
Elliott Co..... 7
Lunkenheimer Co..... 4
Penberthy Injector Co.... 11
Reliance Gauge Column Co.134
Wright Mfg. Co.....102

Alternators
Allis-Chalmers Co.....148
General Electric Co.....161

Ash Ejectors
Parson Mfg. Co..... 77

Bearings
Cresson Co., Geo. V.....106
Hess-Bright Mfg. Co.....120
Royersford Foundry & Machine Co.....108

Belt Dressing
Dixon Crucible Co., Jos....100
Garlock Packing Co..... 9
Keystone Lubricating Co.. 3
Rhoads & Sons, J. E.....124
Robertson & Sons, Jas. L.. 79
Schieren Co., Chas. A., 1st cover
Stephenson Mfg. Co.....157

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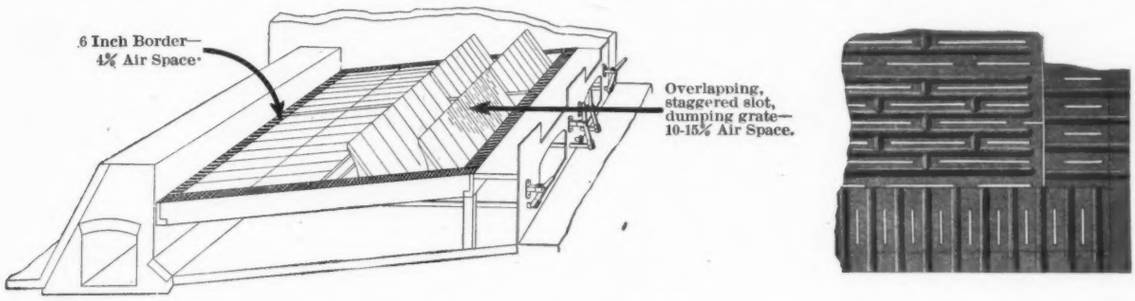

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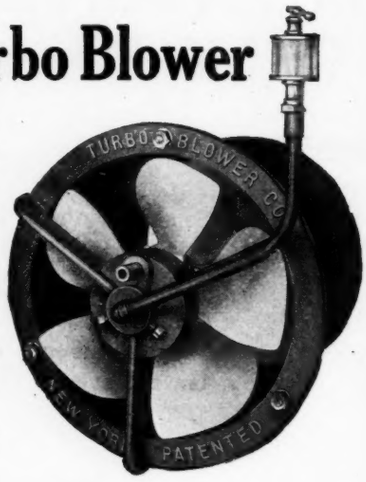

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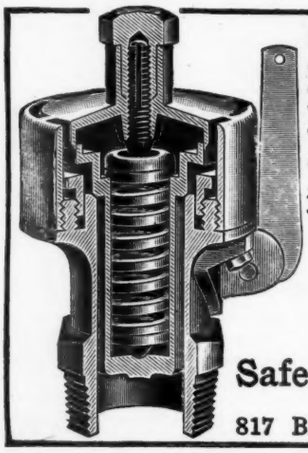

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